PERFORMANCE TESTS OF INTELLIGENCE UNDER INDIAN CONDITIONS

C. M. BHATIA

WITH A FOREWORD BY
GODFREY H. THOMSON

OXFORD UNIVERSITY PRESS

Non-verbal tests of intelligence are of special importance in this country, where a large number of different languages are spoken and where most children are unable to read or write. Dr Bhatia therefore has devised and standardized a battery of performance tests which can be used to test the 'total intelligence' of Indian boys between the ages of 11 and 16. The standardization is based on the scores of 1154 subjects, 642 of whom were literate and 512 illiterate, and the testing was carried out by the author himself and by a group of specially trained postgraduate students. The factorial analysis, standardization, and validity of the results are described, and conclusions as to the relative intelligence of illiterate and literate, 'backward' and 'higher' communities are reached. Full instructions for carrying out the tests are given.

Dr C. M. Bhatia is the Director of the Bureau of Psychology, Allahabad, and in the standardization of his battery he was guided by Professor Godfrey Thomson Edinburgh.

Rs 10

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UNDER INDIAN CONDITIONS

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FOREWORD

I am very glad to have the opportunity of writing a short introduction to this book by Dr C. M. Bhatia, both because of my regard for the author, who was for two periods of one year each a student in my department in Edinburgh, and because of the value of the work in which he is engaged, of which this is a sample. It is of the greatest importance to India, and therefore to the world, that her rising generation should be well educated, each in the way best fitted to his or her talents, and that her manpower, in adulthood, should be helped into those occupations most needed by the nation, most likely to profit by the individual's special abilities, and most likely therefore to make him happy and self-respecting. The object of the testing movement, in which Dr Bhatia is an acknowledged expert, is exactly to forward such aims, not by dictatorial direction but by careful assessment of abilities, general and special, and helpful recommendations based on such assessment. The present careful piece of research is a part of the attempt to improve these methods still further. They have already reached a stage in which their results, when obtained and interpreted by trained psychologists, can be acted upon with considerable confidence in their validity.

GODFREY THOMSON

Edinburgh,
August, 1954.

PREFACE

Modern Psychology has now developed to such an extent that works on Intelligence Testing need neither an apology nor a long introduction. For although the sceptical critic, who will always remain, sees in the Intelligence Testing programmes only the existence of a fad, or at best the manifestation of a social philosophy of life he can never reconcile himself with, it must be recognized that Intelligence Testing—and more generally Mental Testing—has been accepted as useful and essential in all progressive democratic countries of the world. Such testing has led to greater individual and national efficiency—and consequent happiness, perhaps—than could otherwise have been achieved.

Intelligence Testing programmes are now being employed widely in countries such as the U.S.A. and Britain, but are not equally common in the less advanced countries. Indeed, in many of the latter countries, they have yet to establish themselves on proper scientific lines, although it is really in these countries and among their people, who have yet to rise to the height of their nationhood, whose mental powers have yet to be tapped and whose educational systems have yet to be fully developed, that the potentialities of the Intelligence Testing programmes are the greatest. In India, Intelligence Testing is particularly necessary and can contribute much to the national welfare. Its utility, which hardly needs to be emphasized here, has already been discussed by the author at length elsewhere.* The present work is the outcome of the author's belief in the essential utility of Intelligence Testing for his country, and seeks to set up a Battery of Performance Tests of Intelligence for use under Indian conditions. It describes the standardization and use of the battery for both literates and illiterates.

For the successful completion of this work, the author's profound thanks are due in the first place to Sir Godfrey Thomson, Professor of Education in the University of Edinburgh, not only

* Bhatia, C. M. (1949): *Intelligence Testing and National Reconstruction*, pp. 71-6. Bombay: Hind Kitabs.

for his general guidance involving a long and difficult correspondence with the author in India during the war years (1942-6), but for the great interest he took in this study throughout, till it was completed in Edinburgh in 1951. Without his encouragement and interest this study would not have been possible. To Mr W. G. Emmett, of the Department of Education, Moray House, University of Edinburgh, the author is greatly indebted for guidance in the statistical part of the work, and to Dr Mary Collins, Department of Psychology, University of Edinburgh, the author's sincere thanks are due for general help in regard to the Performance Tests.

The author would also like to put on record his deep sense of gratitude to Shri B. N. Jha, B.Ed. (Edin.), his old and respected teacher (now Director of Education, Uttar Pradesh) who initiated him into the study of Educational Psychology, and to Dr I. R. Khan, Ph.D. (London), then Principal, Government Training College, Allahabad, for their sustaining help and encouragement in the project over a long period of time when circumstances often tested the author's patience severely. To his old students of the Government Training College, Allahabad, and especially to Sarvashri Ram Surat Lal, M.A., L.T., S. N. Mehrotra, M.A., L.T., B.Ed. (Edin.), Ram Gopal Misra, M.A., L.T., Gur Mauj Prakash, B.Sc., M.Ed., N. B. Khare, M.A., L.T., G. S. Lal, M.A., L.T., and R. K. Dimri, B.Sc., L.T., the author's thanks are due for help in various ways throughout, and particularly in the administration of tests. To Shri S. N. Kalla, M.A., L.T., also his old student then specializing in Art at the Government Training College, Allahabad, the author is indebted for the original picture which forms the fifth sub-test of the Picture Test.

Lastly the author takes the opportunity to thank sincerely the heads of various educational institutions and also the various friends in different villages scattered over the whole of Uttar Pradesh for their co-operation, which alone made testing in their respective spheres possible in those times.

Allahabad, C.M.B.
14 July 1953.

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I. HISTORICAL RETROSPECT

Intelligence Testing in India

Experimental educational psychology has had rather a chequered, although a fairly long, career in India. The first attempt at a fairly wide and scientific Intelligence Testing goes as far back as 1922 when Dr C. H. Rice of Lahore developed his Hindustani Binet-Performance Point Scale,[1] meant primarily for the children of the Punjab. Nothing commensurate with this initial effort seems, however, to have been undertaken in the later '20s and '30s. Perhaps there was more than one reason for such a failure to keep up a sustained effort. The country is vast, with a huge population giving rise to a number of difficult problems, both of an organizational as well as of a theoretical nature. There was no corresponding organized effort to tackle them.

Thus the history of Intelligence Testing in India in the '20s and '30s is the history of spasmodic efforts of well-meaning and enthusiastic educational psychologists who had had the benefit of coming in contact with some of the best centres of Intelligence Testing in Britain and other countries. Towards the end of the '30s some efforts occurred which may be mentioned here. In 1939, Dr Kamat of Bombay issued his revision of the Binet Tests, which could be used amongst Marathi and Kanarese speaking children.[2] In 1942, Dr Sohan Lall of the U.P. constructed and standardized a verbal group test of intelligence for 11 plus school-going children of the U.P. The test was in Hindi and Urdu and was employed for perhaps the first survey of its kind, undertaken in India, of the intelligence of school-going children.[3]

Since 1940, Intelligence Testing seems to be acquiring more and more momentum. This has been due to the accumulation of spasmodic individual efforts such as the above, to the work of the War Services Selection Boards of the Government of

India and to a growing realization by many State governments that intelligence testing techniques were useful to the nation. Experimental Psychology sections were opened in many of the postgraduate Teachers' Training Colleges and Universities after 1940, and within the last three or four years full-fledged Psychological Institutes and Bureaus, mostly attached to the Education Departments, have been established on a State basis in many parts of the country. These are charged with the specific task of putting psychological testing and other allied activities on a sure footing.[4]

The Indian Background

The first task for psychological work in India is the production of suitable mental tests—intelligence, attainment, aptitude, personality, etc.; intelligence tests being of course of the first and primary importance. This has to be considered against the background of Indian social and cultural patterns. Now perhaps the most characteristic feature of Indian life is the existence, side by side, of two clearly marked groups—the one which has had the benefit of literacy and formal education, and the other which has been deprived of it. The literate and the illiterate groups are generally coincident with the urban and rural sections of the populations, although of course the two are not identical. For there might be many in the cities who may not have received formal education, and conversely, there are a large number from the villages, who, especially during the last three or four years, have been put to some school or the other. Proportionately the illiterate group is very much larger than the literate group, just as the rural population is very much larger than the urban.

Another aspect of the cultural pattern to be noted is that urban and rural environments provide a much more contrasting set of experiences to their residents in a country like India than they do in well-developed countries of the West. Rapid and easy

means of communication, together with the employment of scientific devices such as the radio and the telegraph, have practically knit together the rural and urban communities in a country such as Britain. This is not the case in India, where travelling in the interior is very often tedious and sometimes difficult, and where, after reaching a village, one has very few means of knowing what is happening in the outside world, so that after a while one may indeed very easily lose the desire of trying to know anything at all about it. Life in the village, again, is practically all out of doors. The village boy spends his day out in the fields, helping the elder folk in cultivating or in tending cattle. The experience that he comes across is the handling of concrete objects and materials. Thus the experiences available to village children, particularly those who have never been to a school, are indeed very different from those of the urban children even if the latter have not been to a school either.

It will thus be seen that an attempt at the intelligence testing of the general Indian population, which must of course include the rural population and the illiterates, is a complex one and is beset with a number of major difficulties. Many of these are of an organizational nature in view of the vastness of the numbers involved. But also, not a few are of a theoretical fundamental nature. The most important of the latter, which an investigator has to face at the outset, is the problem of the extent of the environmental factors influencing the achievements of the subjects in the intelligence test. For, as has been indicated above, there is not only the obvious distinction between the literate and the illiterate groups, and between the rural and urban groups, but also other subdivisions within these groups may be discerned even if we exclude, for the time being, groups such as the aboriginals. In attempting to formulate a scale of intelligence tests for the larger sections of the Indian population one must not only be careful to see what groups it is intended for, but that suitable standards for assessing the results are laid down for the group. Unless such precautions are taken, intelligence test results may

not only be of little use, but intelligence testing itself may come into disrepute. We are at present only able to see many of these problems in a nebulous form ; their outlines will be defined after the first few investigations. None such, to the knowledge of the present author, have yet taken place even on a modest scale, so that the field of investigation is quite virgin, offers few landmarks for one to follow and has to be carefully trodden.

The Present Investigation

The attempt in the present investigation has been to formulate a test of intelligence which may reach as much of the Indian population as possible and not merely touch its fringes—the educated middle class. From the above discussion it will be evident that it is not safe, at least in the present state of our knowledge of the cognitive make-up of the various sections of the Indian masses, to attempt a test of intelligence equally applicable to *all* sections of the Indian population. Nor has that attempt been made here. What, however, has been tried is the formulation of a test of intelligence which may be used with much larger sections of the population than has been possible with some of the tests attempted so far, and which will thus open up a field so far completely closed to the Indian educational psychologist. The investigation was bound to raise more problems than it would solve. The solution of all the problems inherent in such a task could not be expected, but the clear formulation of at least the more important of these problems could be looked forward to, with some suggestions of their possible lines of solution.

It is obvious that the type of intelligence tests which could be considered for this purpose are the Performance Tests of the intelligence—or at any rate those tests of intelligence which do not require reading and writing on the part of the subject. Types of tests which fall in the category of Verbal Tests of intelligence were completely ruled out, although a test which could be administered orally and be scored by means of an oral response

on the part of the subject, as for example the Immediate Memory Test, could be included. It was clear that most of the tests would have as their basis the actual manipulation of varied concrete materials by the subjects. Some oral tests of the Immediate Memory type could also be taken up. Also it was evident that only individual testing could be taken up.

The battery of Performance Tests, or more accurately Non-Verbal Tests, which will be described in Chapters II and III, was used to test illiterate as well as school-going children. This was done not only because the battery was meant to be used with both the groups, but also to make a comparative study of the two groups. Performance Tests have not been tried in India on a wide scale even amongst the school population, and the results of testing illiterates could easily be expected to bring out some unusual features. The standardization of the battery of tests has been done for the literate and the illiterate groups separately.

The data collected from the literate group sets up the battery of performance tests as a test of intelligence for school-going children which is expected to reveal very useful information as a supplement to verbal tests of intelligence. Also, as the battery of performance tests is an individual test, it has been found by the writer and the other testers who have used it to be very useful from a clinical point of view.

The age-range selected for the investigation was 11 to 16 years and only boys were included as subjects, girls being excluded altogether. Girls were excluded not only because of the discovery of sex differences in recent investigations of the Performance Tests and the Space factor,[5, 6] but also because there were social difficulties in securing girls as subjects; and we did not wish to complicate this initial investigation by an unnecessarily large number of factors. We decided upon the age-range 11 to 16 years as it was the most convenient of approach and the most suitable for investigation. The total number of boys tested for purposes of standardization was 1,154, of which 642 were school-going and

512 were illiterate boys. The school-going group includes a group of 100 boys who were also given the Terman-Merrill Intelligence Test—Form L (1937 Revision), for purposes of analysis of data.

We turn in the next chapter to a discussion of the theoretical basis of the selection and construction of our tests.

II. THE NATURE OF INTELLIGENCE

Early Notions

Ever since the day Binet successfully measured intelligence in a scientific manner, the problem of an exact definition of intelligence has been faced by psychologists with ever-increasing urgency. The nature of intelligence had been debated upon from very ancient times, but then it was mainly a philosophical discussion with no particular objective facts to explain. With the advent of Binet's methods of measurement of intelligence, the problem took a concrete and sharply defined shape. The question now was not so much: 'What is Intelligence?', as, 'What are the mental characteristics which are assessed through Intelligence Tests?' and those who used the tests expected that a definite answer would be forthcoming to this latter question. A unanimous answer has not been forthcoming, but differences have of late narrowed down very much in spite of assertions which are sometimes made to the contrary.[7] There is in fact much less real difference of opinion now than perhaps appears at first sight; and, of the differences that do persist, their nature is so clearly perceived, especially since the advent of the modern methods of factor analysis, that the present-day psychologist can work ahead with clear lights in spite of the differences.

It is well known that Binet was not particularly eager to venture upon a theoretical definition of the 'intelligence' which his tests measured although he evidently regarded it as a general cognitive ability of an inborn nature. His working concept for measuring it, however, was in the words of Galton some years earlier, 'to obtain a general knowledge of the capacities of a man by sinking shafts, as it were, at a few critical points'.[8] Binet utilized different mental activities at different age-levels for obtaining an index of an individual's intelligence. Binet used

his uncommon insight to decide as to which of these activities at the different age-levels did contribute to the individual's intelligence; and it is a tribute to Binet's genius that without working upon a formal hypothesis he still was able to give us tests which have stood the test of time and which have been shown by later analyses to possess characteristics now commonly accepted as valid features of a test of intelligence.

A great effort towards the clarification of the concept of intelligence was the famous symposium of 1921 in which almost all the leading psychologists of the day participated. The symposium however did not produce very encouraging results from the point of view of a concurrence of opinion. Different psychologists seemed to emphasize different mental aspects as essentials of intelligence. Terman, for example, stressed capacity for abstract thinking, Dearborn capacity to learn, Colvin adjustment to environment, and so on.

However, if we examine some of these earlier definitions of intelligence closely, it is not their differences which appear to us now so striking as is a lack of the real explanation of intelligence in essentially psychological terms. For even if we accept, for example, 'capacity to adjust to environment' as an essential characteristic of intelligence, it does not lead us very far towards the understanding of its psychological characteristics, for we have still to inquire as to what mental structure or activity is the cause of a capacity for adjustment to environment. Very much the same criticism is applicable to other definitions, such as 'capacity to learn', or even 'capacity for abstract thinking'.

The practical psychologist, therefore, did not gain much from these formal definitions of intelligence, and the fact that all of these, at least apparently, differed from one another only added to the confusion of the times. The 1920's were however a period of much active field work on intelligence test construction by workers such as Thomson, Burt, Ballard, etc., and of brilliant theoretical research (based on experimental data)

initiated by Spearman. Things therefore could not, and really did not, remain static, and ideas about intelligence began to take shape at this period.

From the point of view of actual test construction we note this crystallization of views if we examine closely the views expressed at that time by two of the foremost workers on intelligence test construction in Britain and America—Godfrey Thomson and L. L. Thurstone. Thomson,[9] in an article on 'The Nature of Intelligence', at first discussed the general nature of mind and intelligence in the following words:

I prefer to think of the mind as much more complex, and the kind of complexity I mean is very like the kind of complexity found in the brain and the nervous system. The latter is composed of units, which, however, are connected and inter-connected in an infinity of ways. I believe it correct to say that they are more numerous, and their interconnections yet more infinite, as we ascend the scale of intelligence in the animal kingdom, the most so in man. In the same way the mind, it seems to me, has an innumerable array of responses to situations, which responses are interconnected in a tangle of associations, within which tangle are distinguishable various plans or patterns: distinguishable yet not distinct, as the concealed puzzle picture is distinguishable in the drawing of a landscape.

The progress of instinct to intelligence, therefore, seems to me to imply, or to make probable, a 'general ability' by releasing the responses from their specific character and binding them, though in unequal degrees, to a larger number of situations.

Later in the article he summarized his views on the characteristics of intelligence in the following words:

It is in this grasping of relations, for which, above all, words or substitute-symbols are required, that some have seen the essence of general ability, and there is a great deal of truth in their point of view. Among the most successful tests of general ability are those which require it, notably the Ebbinghaus Combination or Missing Word Test and Mr Burt's Analogies.

Similarly Thurstone, in an article on 'The Nature of Intelligence',[10] discussed the general nature of intelligence in the following words :

I want to show that the degree of intelligence in behaviour can be judged by the degree of incompleteness of alternatives in the trial and error life of the actor and that the higher cognitive categories constitute incomplete conduct in the process of being formed. Overt trial and error without foresight is the most unintelligent kind of conduct.

I have outlined what I consider to be the main characteristic of intelligent conduct, the transfer of trial and error point from overt alternatives to percepts, from percepts to the still more tentative ideas, and from ideas to the still more approximate actions that we know as concepts.

Later he summarized in the same article the essential feature of intelligence in the following words :

Several inferences can be made regarding the construction of tests for the measurement of intelligence if we accept this definition. Obviously those questions would be the best measurements of intelligence which indicate the degree of abstraction of which the subject is capable. Experimental studies of Binet test questions have indicated that the questions which are relatively abstract for their respective ages are the best measures of intelligence.

It would thus appear that there is not much essential difference in the views of the above two psychologists in regard to the most characteristic feature of intelligence, at least from the point of view of test construction ; for 'grasping of relations' and 'capacity for abstraction' are, at the most, but two different aspects of the same characteristic, 'abstraction' being essentially dependent upon a capacity to 'grasp relations', and this itself leading on to higher and still higher forms of 'abstraction'.

Similar convergence of views as to the essential feature of intelligence, as measured by tests of intelligence, is found in the views of most other psychologists when we make a close analysis of the implications of their statements. It will suffice

here however to quote further only the views of S. C. Kohs who as early as 1923 devised his Block Design Test which has proved to be one of the most effective tests of intelligence up to the present time. Kohs was quite emphatic about his views on intelligence and even went as far as to try to justify them on philosophical grounds. Be that as it may, his emphasis on the 'analytic-synthetic' activity of the mind as the most characteristic feature of intelligence seems to be very pertinent to our discussion and seems clearly to point to the convergence of the views on intelligence which we are hinting at. Kohs'[11] description of the synthetic and analytic activities was in the following words:

1. By 'synthesis' we mean, on the one hand, the intensity of that fundamental force or condition innate in nervous protoplasm which binds neurons into complex systems, and, on the other hand, the capacity of a living organism to construct out of mental elements and fragmentary experiences, concepts and notions of a higher order.

2. By 'analysis' we mean the capacity for observing or discovering parts or differences in objects or qualities which for themselves seem unitary.

3. Although one can only speculate on these matters, it seems reasonable that analysis and synthesis are but the head and tail of a single function-tendency. This 'analytic-synthetic' activity may be regarded as a fundamental property characteristic of all irritable tissue, and more markedly so of nervous tissue. All forms and degrees of this function-tendency seem possible, from the simplest to the most complex.

And, finally:

It seems evident that if one is born with good mental endowment his brain will 'synthesize' to a degree and in a manner impossible to one whose mental endowment is poor.

This points very clearly indeed to, if not anticipating, the famous Principles of Noegenesis first clearly and emphatically stated by Spearman[12] as the basic psychological characteristics of his g factor in intelligence. Spearman deserves great credit

indeed, as all original thinkers are entitled to, for crystallizing and stating in unambiguous terms what others before him and contemporaneously with him had also been concluding about the essential nature of intelligence, though in less clear and precise terms. For Spearman's famous Laws of Eduction of Relations and the Eduction of Correlates are nothing except a formal statement of the 'analytic-synthetic' activities of the mind, or a capacity for 'grasping relations' referred to above. With the enunciation of Spearman's characteristics of *g* in 1927, a landmark was reached in the discussions on the fundamental nature of intelligence.

Spearman's *g*

Spearman was, of course, emphatic in explaining intelligence on the basis of a *g* factor which he regarded as something of a psychological 'reality'. His devotion to a *g* factor, which he considered to be mathematically established on the basis of experimental data, led to his adherence throughout his life to his famous Two-Factor Theory of Intelligence. Now, although there is no harm, and indeed it is useful from the practical point of view, in talking in terms of a unitary *g* ability in intelligence, we must realize the danger of ending by reifying *g* in a manner and to an extent which is neither warranted by observed facts nor desirable for the ultimate understanding of the essential nature of the cognitive mind. Mathematically the fallacy in postulating *g*, as has been demonstrated by Godfrey Thomson[13] quite clearly, is that although the postulation of a *g* factor will result in a hierarchy of correlations as observed in the experimental data, the converse is *not* true. That is to say, the hierarchy as observed in the experimental data need not necessarily be the result of a unitary factor. It is therefore not correct to regard a *g* ability as established on the basis of a hierarchy of correlations alone. We may accept a *g* factor on other grounds, for example, of practical convenience, and reject it and substitute it by other hypotheses when a truer picture of the cognitive aspect of the

mind in its fundamental forms is aimed at. To many, including the present writer, it appears that although the acceptance of a *g* factor is convenient and useful from many points of view, a truer picture of the nature of intelligence will ultimately be obtained on the basis of a theory such as Thomson's Sampling Theory. For one thing, it is evident that any successful theory of intelligence must take into account the immense complexity of the mind even in its cognitive aspects.

These fundamental considerations apart, Spearman's *g* has provided a very useful basis for the development of subsequent ideas on intelligence. One of the immediate developments of the acceptance of a *g* ability was the demonstration of the existence of several other fundamental cognitive abilities, the chief of which we may at the moment, for the purpose of our discussion, consider to be *v*, *F* and/or *k*, *n* and *M* (memory). Some, like Thurstone,[14] have preferred to talk in terms of these other abilities alone, termed as 'primary mental abilities', and have neglected a *g* ability. Others regard the acceptance of these, in addition to the *g*, as the more desirable and useful practice.

The main result, from a theoretical point of view, of the acceptance of the other cognitive abilities besides *g* has been to raise the problem of their interconnexion within the structure of the mind and thus to demand a fresh definition, or at least an explanation, of the term intelligence particularly for the purpose of test construction. Some, like Alexander,[15] have seen in the other abilities, particularly *v* and *F*, a medium through which *g* works, thus giving rise to terms such as 'verbal intelligence' and 'concrete intelligence', symbolically denoted by *gv* and *gF*. It would appear to the present writer that suitable though such terminology may be for practical purposes, too much emphasis on such terms or expressions would lead to the danger we hinted at above, namely reification of factors which have in fact an existence only on analytic grounds. It is best to accept the presence of factors demonstrated unequivocally and utilize them for analytic purposes, but not in every case necessarily identifying them with

a parallel mental or physiological counterpart. The overall picture of intelligence, however, can perhaps be best approximated, in the present state of our knowledge, by what Vernon[16] has recently stated to be the 'hierarchical group factor theory of the structure of abilities'. This accepts the simultaneous existence of *g* and other abilities as essential parts of an integrated cognitive make-up generally denoted by the term intelligence, leaving the question of the type of their integration rather open.

In this connexion mention may be made of two useful terms —'basic intelligence' and 'total intelligence'—first introduced by Burt and Enid John[17] although in a rather different context. They state:

> We may treat general intelligence either as a kind of sum or average of a man's cognitive abilities, or as a basic quality to which other abilities are added. Nor is it necessary to argue which interpretation is the more correct, since they are not really incompatible. For theoretical purposes the more usual view is probably the more acceptable, namely, that which treats intelligence as something fundamental, with the verbal, numerical and other abilities superimposed: but for practical purposes it is perhaps more helpful to treat the tests as measuring not 'basic intelligence' (as we may call it), but 'total intelligence'.

This, it appears to us, is a very sound summary of our present understanding of the nature of intelligence and may well be adopted as a guide by those who venture to take up the construction of intelligence tests, especially under conditions where intelligence test construction is not yet common, and has not become a routine matter.

The notion of 'total intelligence' is also helpful in test construction from another point of view. It is known that 'pure' tests of *g*, or in fact of any other ability, are hardly feasible if not impossible. A test which contains a single factor, for example *g* alone, nevertheless contains a large amount of 'specific', even if it does not contain any other known factor. The consequence is that not only is the saturation of *g* itself in such a 'pure' test of *g*

never quite so high as it is in the case of 'mixed' tests such as those, for example, of $g + v$, but such a 'pure' g test is never able to compete for predictive purposes with the mixed tests. For in our actual everyday life, whether in the educational, vocational or social sphere, it is not the pure g that is in demand, although that may be the most important element, but usually it is its combination with several other abilities, such as v or k or F or n, that is actually needed.

Our conception of a suitable intelligence test therefore is that it should test the fundamental analytic-synthetic activity of the cognitive mind, the power to 'grasp relations', or the 'capacity for abstraction' under appropriate circumstances, together with and through the medium of such other cognitive mental activities as are natural to the social and cultural environment of those for whom the test is being framed. While recognizing the supreme importance of a g ability in an intelligence test, we consider the introduction of other appropriate abilities essential for the success of the test; or, if one may put it the other way, we consider the assessment of g through as many and as varied mental media as possible to be a desideratum for an intelligence test. Commencing with the essential basis of the g ability, we have, therefore, made our battery of tests as comprehensive as possible.

Performance Tests

The performance type of tests which alone come within our purview have often been severely criticized, and perhaps rightly so, for failing to evaluate successfully, or at least as successfully as it is desirable, that which an intelligence test ought to evaluate. Cattell,[18] for example, in the 1936 edition of his *Guide to Mental Testing*, said, 'unfortunately the great majority of performance tests have quite low and even negligible correlations with intelligence. So great is the attraction of performance tests, however, alike to the subject and examiner (for even the psychologist is

not immune to the sense of increased prestige which important looking apparatus gives him) that performance tests are widely used and depended upon, frequently in situations when, in fact, they are misleading and a waste of time.' And, further, in the 1948 edition of the same book,[19] he says: 'The only homage current practice pays to research findings is that one shall not calculate intelligence quotients from performance tests since the briefest experience shows that such intelligence quotients are anything but constant. The score is, therefore, left as a mental age. In the case of those few performance tests that are highly valid tests of intelligence, no attention should be paid to this convention, and the usual IQ is best used.'

Now, although we do not quite agree with the vehemence of this onslaught on the general body of performance tests as such, we are quite in agreement with the principle of this criticism. It appears to us, however, that it is not performance tests as such which are at fault, but the particular performance tests which have often been, so far, put forward for different age-groups. If a performance test of intelligence is applied to an age-group where it is obviously not suitable (usually performance tests are too easy for the higher age ranges) it certainly cannot provide any valid assessment of intelligence. This is, we believe, the case with many of the earlier performance tests such as those given by Pintner and Paterson.[20] All these tests of Pintner and Paterson, except the Picture Completion Test, cease to be effective after the age of 10 or 11 years, since the graphs of the median scores for all these tests become stationary at that age, having reached their ceiling. These tests, therefore, could not be valid for the higher ages.

If the performance tests however are devised so that they are appropriate in nature and difficulty to the age-range for which they are meant, there seems to be no fundamental reason why a performance test should not be as successful in measuring intelligence as the verbal tests, except perhaps for the very

highest mental level. And such successful attempts have not been wanting. Kohs' Block Design Test is a classic example, for although devised in 1923 it still ranks as practically as valid a test of *g* as any verbal test. Collins and Drever's [21] performance tests have been quite successful for the children for whom they are meant. Dr Alexander gave us his Passalong Test in his Battery of Performance Tests which is now in common use and is considered fairly satisfactory. That such successful attempts have not been more numerous is due, in the opinion of the present writer, to a lack of urgent necessity for such tests in the environment of Western Europe and America where testing has been prominent so far.

Further, in the construction of performance tests of intelligence, especially for the higher age-ranges, there is need for greater attention to be paid to suggestions such as those put forward by Terman[22] in his introduction to Kohs' book on Intelligence Measurement: 'In the upper ranges of intelligence especially, most performance tests have but little differentiating value, simply because they do not draw heavily enough upon the higher mental processes'. Thus, performance tests often degenerate into tests for assessing the manipulative capacity (in a physical sense) of the child in connexion with miscellaneous concrete material. Such tests require no rational approach of the mind for their successful solution and easily assume the nature of a puzzle whose solution depends upon sheer chance.

Finally, in the construction of performance tests there is perhaps need for attention to be paid to the general suitability and appeal of the test. A test such as a Picture Completion Test, in which the correct missing pieces have to be put in the holes cut out of the picture, becomes perplexing and uninviting to the subject when the size of the cut-outs becomes so small that details are difficult to notice. Such a test, although suitable otherwise, does not enable the subject to exercise his powers of intelligence suitably.

Principles for the Construction of the Battery

We may then summarize the principles which have guided us in selecting and constructing the tests which constitute our battery of performance tests :

1. An attempt has been made to exercise the powers of analysis and synthesis of the subject to the maximum.
2. A limited number of suitable and graded tests have been brought together. A miscellaneous collection of a large number of tests is not attempted.
3. Within the limitations accepted, the tests are as varied as possible. Problems involving discrimination of patterns in connexion with concrete material (Kohs' Test) and those requiring discrimination in connexion with the movement of concrete material (Passalong Test) have been included. Also are included a Picture Construction Test (devised by the author) requiring discrimination in terms of picture parts, and a Pattern Drawing Test (devised by the author), involving analysis in terms of lines.
4. Since a broad basis for the assessment of intelligence was aimed at, an Immediate Memory Test (suitably adapted by the author for illiterates) was also included, since it was possible to administer such an adapted Memory Test even to illiterates.
5. The general suitability of the tests was carefully kept in view.

III. THE BATTERY OF TESTS

The building up of our battery has been a gradual process. We started in 1942 with the Kohs' Block Design Test using all the seventeen designs. Applied to children of local schools, it appeared to work quite satisfactorily. The children felt interested and attempted the tests with great zest. Not all of them, however, were equally successful at their solution, and even a cursory scrutiny of the results of a number of children of known intelligence made it evident that the test gave good discrimination, especially for children of ages 11 years and above. The test appeared well worth a detailed and scientific trial for the purpose of standardization on Indian children. The performance on the test also seemed to be correlated positively with chronological age in the age-range 11 to 16 years. No formal paper was worked out at this stage on these results.

This led to the suggestion of trying out the test on village boys, particularly illiterate, of the same age-range because it appeared there was nothing in the test itself which precluded its application to such children. Only the problem and difficulty of the actual administration of the test to these children had to be resolved. For it was known that the problems of testing under village conditions were peculiar and often difficult to handle. A stranger would not obtain the response and ready co-operation from the villager which were essential for any valid testing. The tester would also have to shed many sophisticated notions about the formalities of test administration if he was to be successful at his task. For example, a desk and stools for the use of the tester and the subject would usually be difficult to obtain, and would not be very desirable in any case. The tester would have to sit with the subject on the ground in the familiar Indian style, with his test materials arranged accordingly on a big flat wooden board. It might often be desirable to administer the tests in the open, under the shade of a tree, rather than inside a closed room,

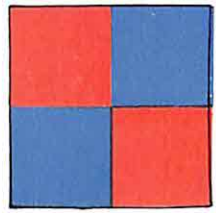
at least to start with, to allay the curiosity of the common villager and to obtain his understanding and co-operation. Of course, many of these conditions are now fast changing and it is hoped may disappear altogether in course of time, but when this work was started they were a serious matter and were often accentuated because of the political conditions. It is therefore with great pleasure that the author can recall now the spontaneous co-operation which he received in those days from many of his students of the Experimental Psychology class of the Government Training College, Allahabad, who were themselves residents of remote Indian villages. One of them, Mr Ram Surat Lall,[23] applied the Kohs' Block Design test under the guidance of the author, in his own and neighbouring villages, and a report of this work was published in a local journal.

The success of this attempt under typical Indian village conditions convinced the author that a battery of performance tests for testing intelligence could be successfully assembled which would give valid results under Indian conditions. Having received support in this from Professor Sir Godfrey Thomson of the University of Edinburgh, the author completed the assembly of the present battery of tests, after numerous preliminary trials, by 1945. The tests finally included were :

1. Kohs' Block Design Test.
2. Alexander's Passalong Test.
3. Pattern Drawing Test (devised by the author).
4. Immediate Memory Test for Digits (with an alternative form suitable for Illiterates, devised by the author).
5. Picture Construction Test (devised by the author).

Kohs' Block Design Test

Although, to begin with, all the seventeen designs as originally given by Kohs were tried, it was found that they took more time to administer than could be spared for a single test of the battery. Also it was found that the extra time was not



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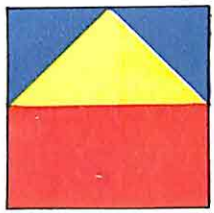

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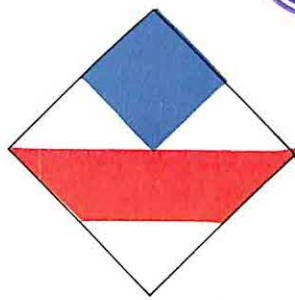

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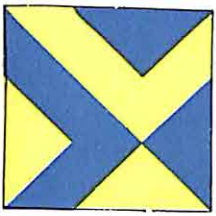
TEST 1

Kohs' Designs Used, Nos. 1-5



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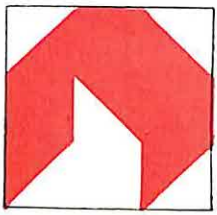

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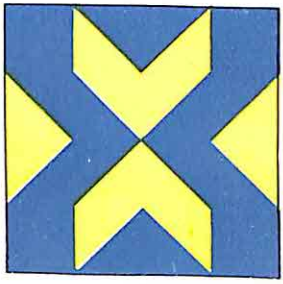

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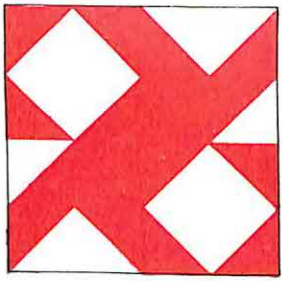

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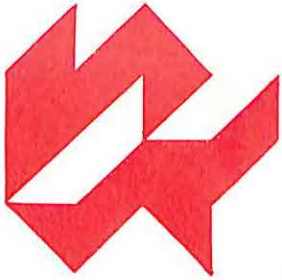

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Kohs' Designs Used, Nos. 6-10

compensated by greater validity in the results. For although the Kohs' Test was good in itself, it needed to be combined with other tests to give a satisfactory estimate of the subject's intelligence. Only ten designs were therefore used, as suggested by Collins and Drever.[24] Our designs are, however, not exactly the same as those employed by these authors. Our designs are Kohs' original designs nos. 1, 2, 4, 5, 7, 10, 11, 15, 16 and 17, and thus differ from Collins and Drever's in the case of the last three. We found it necessary to include Kohs' design no. 17 in order to obtain a higher ceiling. The time limit for the first five designs is 2 minutes each and for the last five designs 3 minutes each.

Complete and detailed instructions as issued to the testers for administering this and other tests of the battery are contained in the Instructions Booklet reprinted in the Appendix.

Alexander's Passalong Test

We used Alexander's Passalong Test practically as given by him. Instead of his 9 sub-tests, however, we used only 8, omitting his third sub-test. The time limit for the first four sub-tests was 2 minutes each and for the last four, 3 minutes each.

Pattern-drawing Test

This is a test devised by us specially for this battery. The idea of this test grew from observation of some of the common pastimes of boys in India, in both urban and rural areas. One such is to draw different shapes on the ground or sand with the help of a stick, or on paper with the help of a pencil. Often the drawing is done under various imposed conditions. Indeed quite a number of the less active, indoor, games depend upon drawing of diagrams of this type. The condition which we imposed was, 'When once you have started drawing, your pencil should not be lifted and no line should be repeated'. This condition was accepted with zest and regarded almost as a challenge by the subjects. There was never an occasion when the condition was not understood

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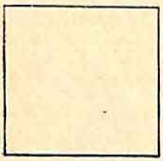

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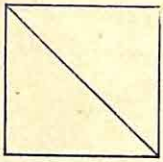

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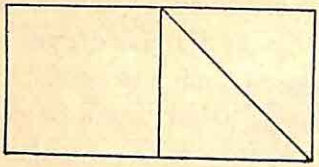

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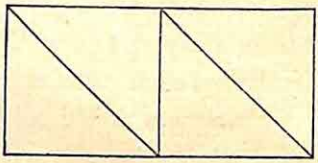

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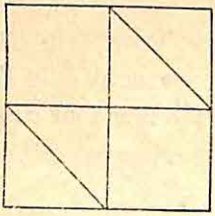

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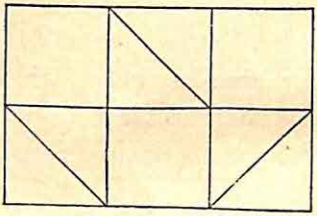

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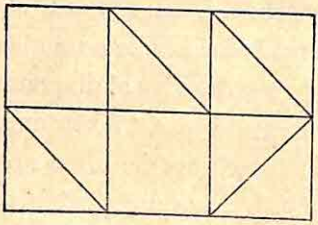

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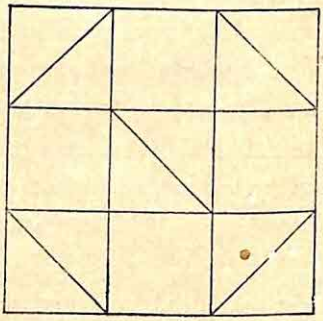

TEST 3

PATTERN-DRAWING

by the subjects or when there was a lack of motivation. The subjects clearly understood that it was not a fine drawing which was in demand but the successful completion of the diagrams under the given conditions.

We finally decided upon the 8 diagrams which form the 8 sub-tests of this test. The first sub-test is just a plain square figure ; the second is a square with one of the diagonals inserted ; the third is the second figure with a square of the size of the first added to it on the left, so that the whole could also be viewed as a rectangle with length : breadth as 2 : 1, divided into two squares, in one of which a diagonal has been drawn ; and the fourth is just the same as the third, but with two parallel diagonals.

The fifth, sixth, seventh and eighth sub-tests become more and more complex. The fifth is a bigger square containing four squares of the size of the first shown in it with two parallel diagonals in two opposite squares ; the sixth is the same as the fifth with two more squares, with an appropriate diagonal, superadded on one side, so that the whole becomes a rectangle 3 by 2, with three of the diagonals shown. The seventh is the same as the sixth but with *four* diagonals instead of three. Finally, the eighth and the last one becomes a square, 3 by 3, with all the smaller squares shown and *five* of the diagonals drawn. This eighth could easily be viewed as an extension of the seventh, and obtained by extending its breadth.

While constructing the test it was discovered by us that, starting with the first small square, the figure could be extended in various ways, keeping the condition that the extended figure should be either a square or a rectangle. Alternative equivalent forms of this test can therefore be easily made. The eight forms which we have at present selected are those which appeared suitable after some initial trials. It was kept in view that as far as possible a sub-test should be built up on the one that preceded it, so as to provide a clue for its solution and make it free from the element of chance as far as possible.

Although we stopped at the eighth sub-test, it is evident that further and more difficult sub-tests can be added if desired. Not all extensions will, however, give figures which fulfil the basic requirements of our problem—namely that no line should be repeated and the pencil should not be lifted when once the drawing has been started, and it has been an interesting problem to the author himself to discover under what conditions such extensions are possible.

This test, although coming under the category of Performance Tests, is really very much akin to some of the 'pure' tests of *g* which have been devised in terms of lines and shapes. It is nevertheless in a form which can be more interestingly administered than some of the more formal *g* tests. It may also obviously contain a spatial factor or component (*k*).

In the actual administration of the test, various interesting features are noted which may be related to the individual's imagery, *k*-factor, or other abilities. For example, to some the mere complexity of the diagram (i.e. perhaps the number of lines in it) is more perplexing than the analytic difficulty involved in discovering the solution. Again, some seem almost to hit the solution at first sight, while others arrive at it by a laborious and, perhaps, atomistic effort.

The time limit for the first four sub-tests is 2 minutes each, and for the last four, 3 minutes each, the subject being free to make as many trials on paper as he likes within the time limit.

Immediate Memory Test

Our Immediate Memory Test for Digits is practically the same as used in Binet tests and as given by Terman and Merrill in their New Revised Stanford-Binet Tests of Intelligence.[25] It consists of two parts, Immediate Memory, Direct and Reversed. We kept the test in two separate parts. That is to say, we begin first with the Direct part and exhaust it by reaching a number of digits the subject is no longer able to repeat correctly. Then we

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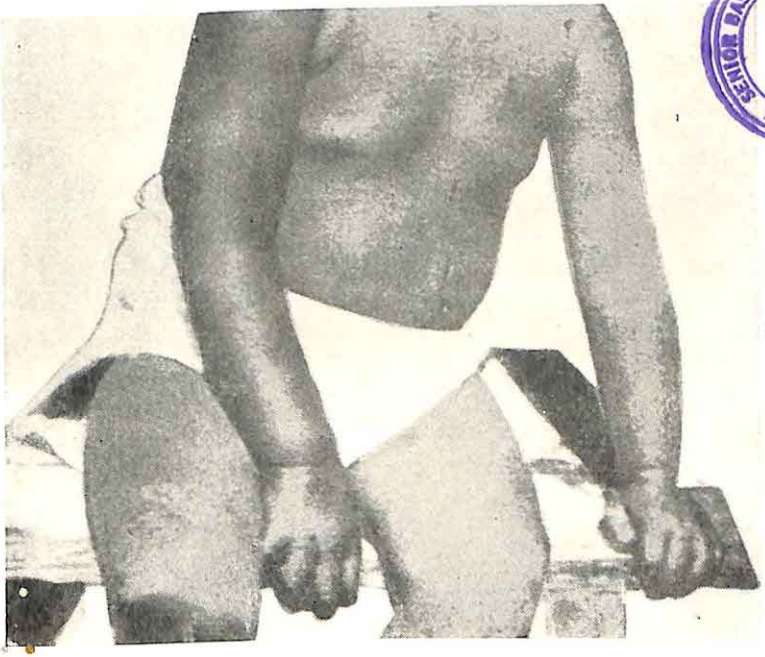

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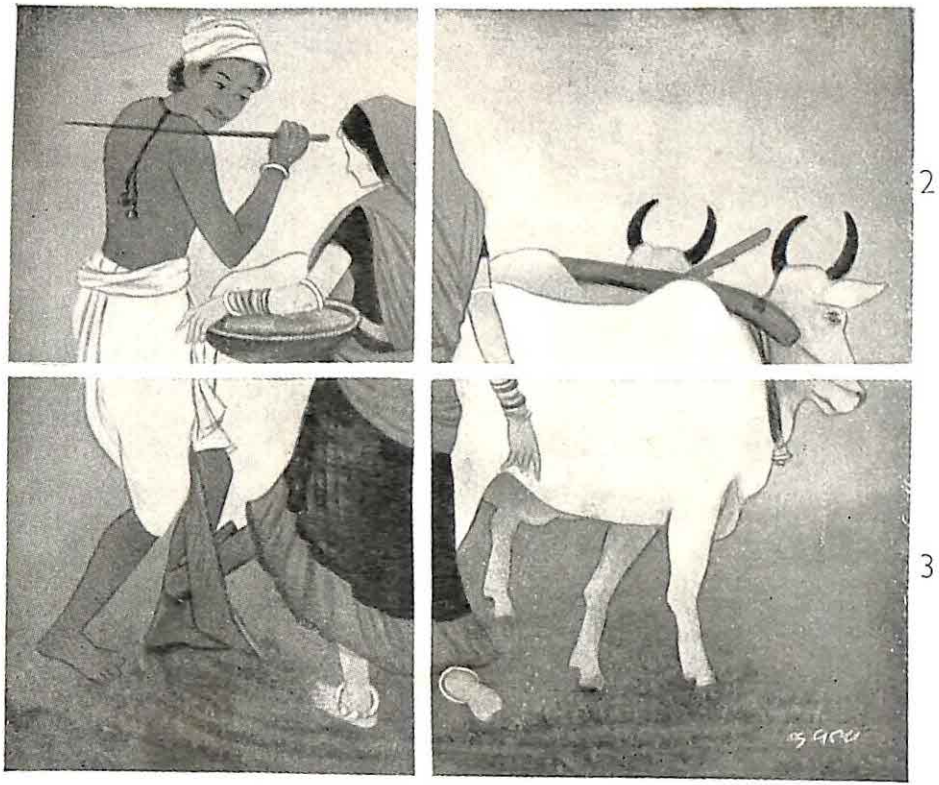
TEST 5

PICTURE CONSTRUCTION

Sub-test 1. Original $7\frac{1}{2}'' \times 5''$

Numbers indicate order in which cards are presented

PICTURE CONSTRUCTION
Sub-test 2. Original $7\frac{1}{2}'' \times 9''$



TEST 4

IMMEDIATE MEMORY TEST

Sounds : Direct

Say :—

ब — र ; स — ट ; प — ल

Say :—

स — ब — क ; ट — प — च ; ल — ट — र

Say :—

ब—र—च—ल ; ट—ल—प—च ; र—च—स—क

Say :—

ट — क — ल — प — स
ब — ल — ट — र — च
र — स — क — ल — ट

Say :—

ब — र — ट — ल — क — प
प — च — ल — र — ब — स
र — च — क — ट — ल — ब

Say :—

र — च — प — क — ब — ल — ट
ब — र — क — प — ट — च — स
क — ब — र — ट — प — ल — च

Say :—

प — ब — स — क — ट — ल — च — र
स — च — प — ल — ब — क — र — ट
ब — र — च — ट — क — स — ल — प

Sounds : Reversed

Repeat sounds backwards

[*as* क — च — ट : ट — च — क] :—

ल — प — च — स

ब — क — ट — र

स — र — च — क

Repeat sounds backwards :—

ल — क — ट — र — ब

स — प — क — ल — ट

प — च — र — ब — क

Repeat sounds backwards :—

ब — र — क — ल — प — स

प — ल — ट — स — ब — त

र — प — च — स — क — ल

IMMEDIATE MEMORY TEST

Digits: Direct

Two	4 — 7 ; 6 — 3 ; 5 — 8
Three	6 — 4 — 1 ; 3 — 5 — 2 ; 8 — 3 — 7
Four	4 — 7 — 2 — 9 ; 3 — 8 — 5 — 2 ; 7 — 2 — 6 — 1
Five	3 — 1 — 8 — 5 — 9 4 — 8 — 3 — 7 — 2 9 — 6 — 1 — 8 — 3
Six	4 — 7 — 3 — 8 — 5 — 9 5 — 2 — 9 — 7 — 4 — 6 7 — 2 — 8 — 3 — 9 — 4
Seven	5 — 3 — 4 — 7 — 9 — 2 — 6 2 — 7 — 5 — 6 — 9 — 4 — 3 9 — 4 — 3 — 8 — 7 — 5 — 2
Eight	7 — 2 — 5 — 9 — 4 — 8 — 3 — 6 4 — 7 — 1 — 5 — 3 — 9 — 6 — 2 4 — 1 — 9 — 3 — 5 — 8 — 2 — 6
Nine	5 — 9 — 6 — 1 — 3 — 8 — 2 — 7 — 4 9 — 2 — 5 — 8 — 4 — 1 — 7 — 3 — 6 4 — 7 — 2 — 9 — 1 — 6 — 8 — 5 — 3

Digits: Reversed

Three	(7 — 3 — 5 : 5 — 3 — 7)
Four	8 — 5 — 2 — 6 4 — 9 — 3 — 7 3 — 6 — 2 — 9
Five	8 — 1 — 3 — 7 — 9 6 — 9 — 5 — 8 — 2 5 — 2 — 9 — 4 — 1
Six	9 — 2 — 7 — 3 — 1 — 4 6 — 4 — 2 — 5 — 8 — 3 7 — 5 — 8 — 6 — 4 — 1

take up the Reversed part and similarly exhaust it by again reaching a number of digits the subject is no longer able to reverse correctly.

However, when we gave this test to illiterate boys in the initial stages of our test construction we were struck by the unusual difficulty these boys felt in repeating the digits or in reversing them. The reason, we soon discovered, was their unfamiliarity with digits, for even if they know the numbers they are certainly not familiar with them in the way that schoolboys are. Whereas the sound of a number, such as 'seven' or 'five', constitutes a *unit* perceptual experience for a literate boy, it is not so for an illiterate boy. The sound 'seven', for example, is almost a set of nonsense syllables for him, and constitutes for him, for the purposes of understanding and memorization, as many units as there are unit sounds in the word.

It became evident therefore that the names of digits would have to be replaced by something more unitary in the experience of the illiterate boys in order to achieve some sort of equivalence of the test for the literate and the illiterate groups. The sounds of the Hindi consonants were selected for this purpose. The Hindi consonants are the same as the Sanskrit consonants, and as is commonly known, are built upon the scientific principle of one consonant for each unit sound, and the converse also, that of one sound only for each consonant, so that the alphabet is phonetic. The consonants used were quite distinctive, such as क (ka), च (cha), ट (ta), ल (la), प (pa), etc.

The Immediate Memory Test, Direct and Reversed, was therefore set to the illiterates through the medium of these unit sounds instead of through digits, but otherwise with no other alteration. The results were found to be definitely more satisfactory.

Picture Construction Test

We included a Picture Test because it constituted a medium entirely different from that utilized by any of our other tests. This is the last test included in our battery.

Our picture test is different from some of the picture tests now in use in as much as, first, the sections are always large, for if details are difficult to recognize the subject's interest may be lost; and secondly the aim is to test the subject's capacity to understand relationships.

Our method of preparation therefore was to cut suitable pictures into a number of parts—2, 4, 6, etc.—according to the sub-test desired. These cut pieces form the materials of the successive sub-tests, which are in ascending order of difficulty. These parts of a picture are presented to the subject in a definite order, and he is asked to put the pieces together to form the picture of which they are the parts.

The pictures have been cut along horizontal and vertical straight lines, so that in the case of every picture (and therefore of every sub-test) the parts are all rectangular in shape, but generally not squares. It was the cutting of a picture into parts, as also the selection of a suitable picture for a particular sub-test, that required careful thought on our part. For the easier sub-tests, the pictures had to contain bolder but fewer details, and human figures had to be prominent. For the later and more difficult sub-tests, landscapes could be used with many, but still not too many, details. The details mostly centred round some human activity or figure. The pictures had to be suitable for Indian children and of fairly good aesthetic taste. Of the five pictures made use of in this test, four were selected from those which were already available in children's magazines and journals. The fifth picture, which constitutes our fifth sub-test, had to be specially drawn to put in details which we desired. The author's thanks for this are due to Shri S. N. Kalla, M.A., L.T., then a student in the Government Training College, Allahabad, who drew the picture under his instructions.

The cutting up of the pictures had to be done in such a manner that essential relationships could be discovered on the basis of intelligent understanding. For example, for the easier sub-tests, parts of the human body were separated which

obviously formed one whole. In the difficult sub-tests, the landscape was divided in a similar manner, and it was very interesting to watch in the actual performance of the subjects how the brighter ones saw the clues and the duller ones just missed them. Again, generally one of the sections of the picture was such as to form the central theme of the picture. The pieces of a picture are therefore presented to the subject in a pile (or in the case of the fifth picture in *two* piles) so that this part containing the central theme (or in the case of the fifth picture, two parts) is at the top and is alone seen by the subject in the first instance, and gives him the proper start. The other parts of the picture in the pile are arranged in a set order to make the presentation uniform and systematic.

The time limit is 2 minutes each for the first three sub-tests and 3 minutes each for the fourth and the fifth.

Some General Considerations

In the making up of our battery of tests, although we had to see that the tests were suitable for the Indian environment, we desired to make use of at least some tests which had already been used in other countries and therefore about which some psychological data was available.

This was not difficult in our case as most of the performance tests can be widely used. We thus included Kohs' and Passalong Tests in forms commonly used in Western countries. We had however to introduce a completely new Picture Test, as an identical picture test would not work under Indian conditions. The Memory Test, as we have already seen, had to be modified for the illiterate group. We introduced the Pattern-drawing Test because of its suitability for Indian children, although such a form has not been employed elsewhere. The advantage of having a mixed battery, composed of old and new tests, was that they could stand comparison with each other in a final analysis. The results of the analysis, given in a later chapter, seem to justify our procedure.

IV. THE TESTING, AND THE SAMPLE USED FOR STANDARDIZATION

The Testing

The testing early resolved itself into two separate categories—that for the urban children, mostly literate, and the other for the rural children, mostly illiterate. The testing of the urban children did not present any particular difficulties, but that for the rural children did, as we have already hinted in the last chapter, and as we shall now describe in detail. The testing, being individual, took a considerable time. It spread itself roughly over a period of four years from 1945 to 1949. Some 1,400 subjects were tested during this period, of which 1,154 have been utilized for the purpose of standardization and analysis. Most of those excluded belonged to the earlier period of testing and in many cases were incomplete in one respect or another. Of the total 1,154 subjects, 642 were literates and 512 were illiterates. They were in the age-range 11 to 16 years.

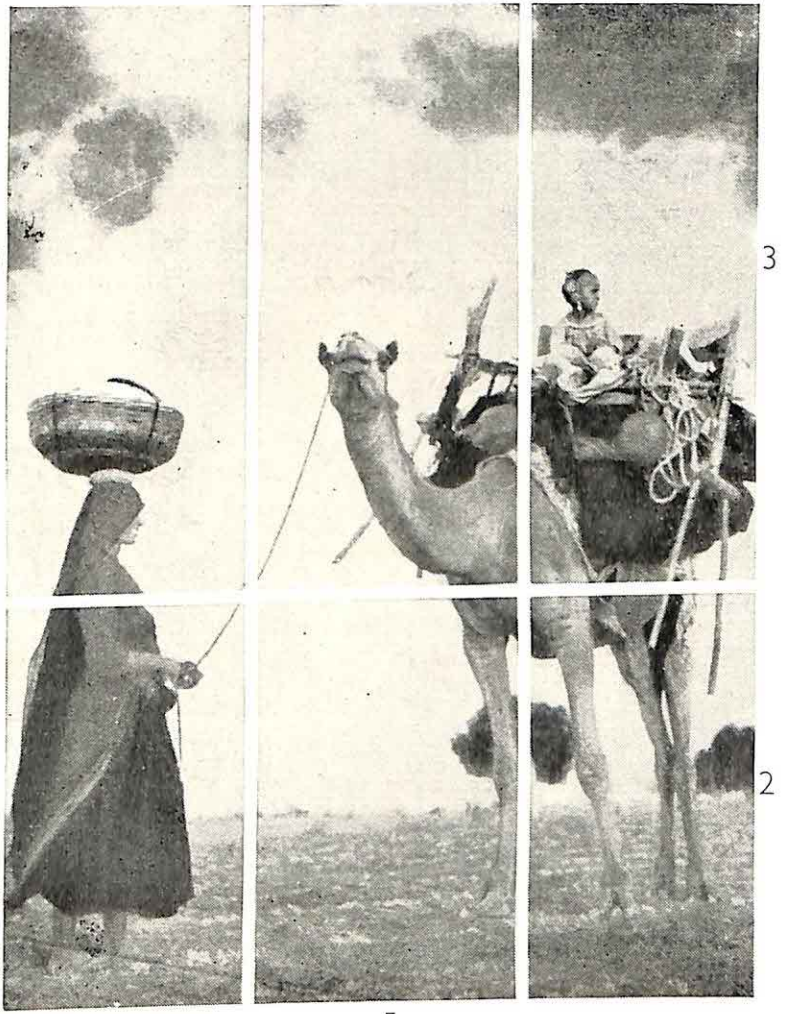
The testing was done by the writer himself and a select number of his students of the Experimental Psychology class of the Government Training College, Allahabad, who had passed out as teachers. They were all postgraduate students with good records in the theory and practice of teaching and had, in addition, taken a full paper in theoretical and experimental Educational Psychology under the author. In the experimental part they had administered the present battery and other intelligence tests to a number of local school children under the writer's supervision, so that when they went out and administered these tests independently they were familiar with the technique of testing. They worked on an entirely voluntary basis, as no financial aid was forthcoming from any quarter at that time, and the writer can now reflect with thankful pleasure on the conviction these young teachers shared with him at that time in the utility of these methods for education, for this alone made the

work possible. A full set of the test-material was supplied to the testers by the author. Quite a lengthy correspondence had to be maintained with each of them, and every opportunity for personal meeting was utilized. About 350 subjects were tested by the present writer and the rest by the other testers, about 200 falling to the lot of each, with literates and illiterates in equal proportion. The testing was done mostly in the long summer vacations which, fortunately, happen to coincide with the off-season periods in the villages. The teacher-testers tested the boys of their own village or town or its neighbourhood (complete groups, as falling within our category, being tested in each area as far as possible), while the present writer visited a number of scattered villages and towns specifically for this purpose. While giving the tests in the villages, the author lived in the villages themselves for a number of days.

The Illiterate Group

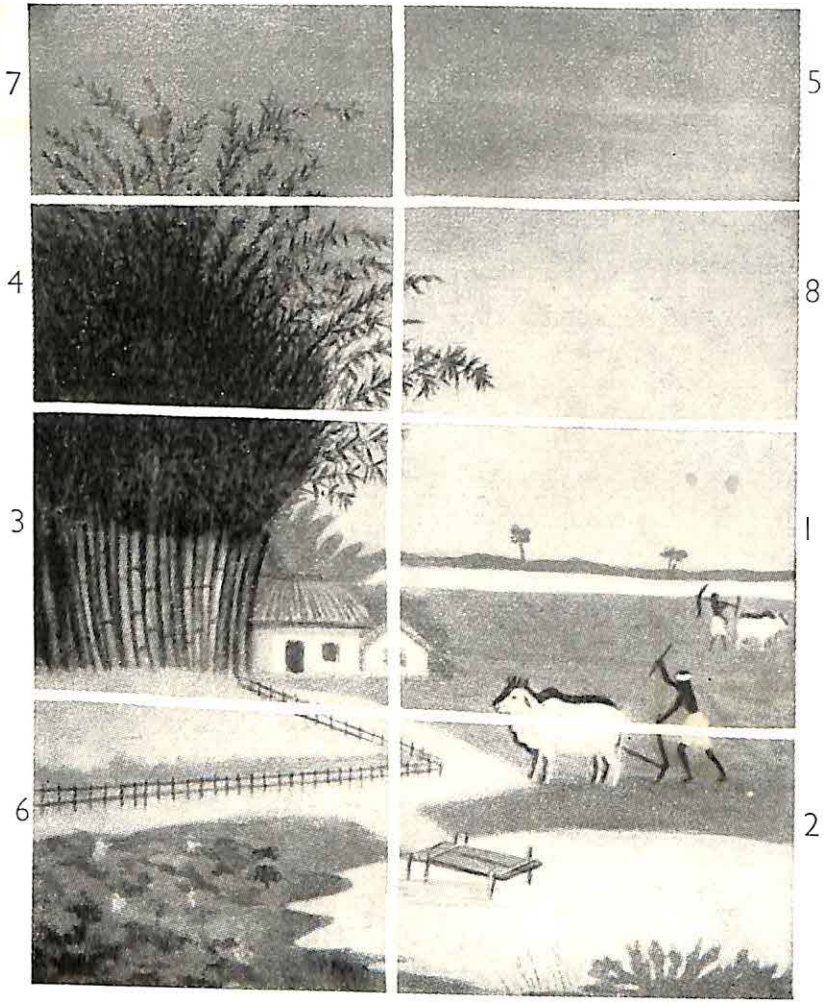
Geographical Distribution. The geographical distribution of the population on which standardization is based is as follows (see also map):

District (with symbol used to denote it)	Number	Percentage of the whole
Mathura Rural (W_1)	44	8·59
Agra Rural (W_2)	23	4·49
Dehra Dun Rural (N_1)	41	8·01
Pilibhit Rural (N_2)	47	9·18
Sitapur Rural (N_3)	41	8·01
Allahabad Urban (C_1)	42	8·20
Fyzabad Rural (C_2)	73	14·26
Kanpur Rural (C_3)	25	4·88
Deoria Rural (E_1)	60	11·72
Sultanpur Rural (E_2)	76	14·84
Jaunpur Rural (E_3)	40	7·81
Total ..	512	100



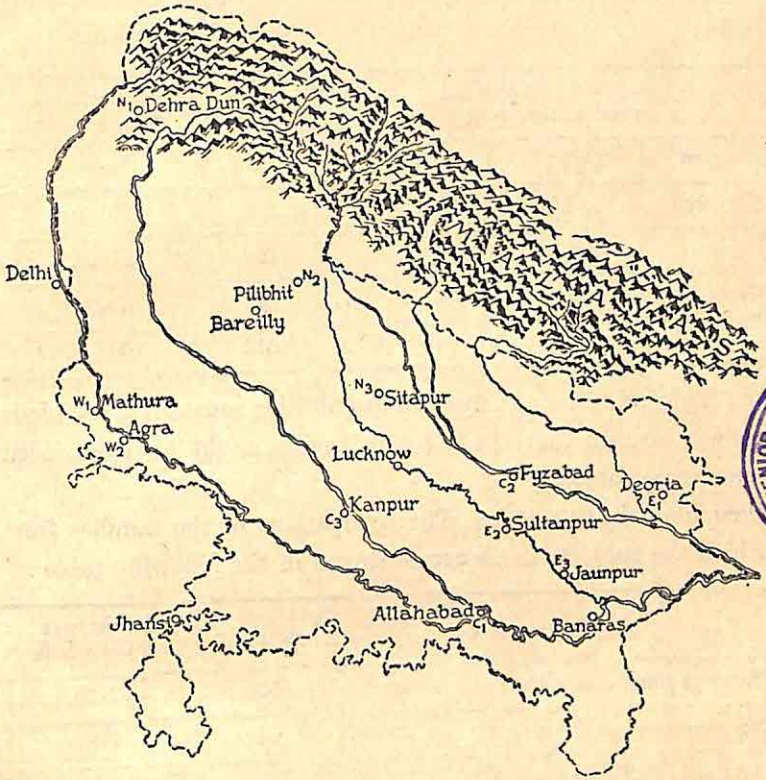
PICTURE CONSTRUCTION

Sub-test 3. Original $7\frac{3}{4}'' \times 5\frac{3}{4}''$



PICTURE CONSTRUCTION
Sub-test 4. Original $9\frac{1}{2}'' \times 7\frac{1}{4}''$

It will thus be seen that fairly equal numbers from various districts lying in the different regions of the state were tested—W stands for the Western region; N for the Northern; C for the Central; and E for the Eastern. In the northern districts was also included one—namely Dehra Dun, Rural (N_1)—which lies in the ranges of the Himalayan mountains.



Map of the U.P. showing the geographical distribution of the illiterate group

The method of securing the sample in a particular district was to select a village, or a group of neighbouring villages, and then to test all the boys coming within our category provided by this group of villages. That is to say, *all* the illiterate boys between the ages of 11 to 16 years were tested without exception.

It was hoped that in this way the sample would be fairly representative.

All the areas were rural, except one, namely Allahabad Urban (C_1) (8·20%). This gives us a proportion of rural : urban as 91·80:8·20, or roughly 10:1. This is also roughly the proportion of illiterates as distributed between rural and urban areas.

Combining the districts regionwise, we have the following table :

Region (with symbol used to denote it)		Number	Percentage of the whole
Western	(W)	67	13·09
Northern	(N)	129	25·20
Central	(C)	140	27·34
Eastern	(E)	176	34·38
	Total ..	512	100

This indicates a fairly even distribution amongst the various regions, except that the Western region might have provided some more subjects.

Occupational Distribution. The occupations of the families from which the subjects came are as shown in the following table :

Occupation	Number	Percentage of the whole
Farmers (including all workers on land)	320	62·50
Shopkeepers (small village)	40	7·81
Artisans and Craftsmen	58	11·33
Labourers (Hired)	29	5·66
Domestic servants	43	8·40
Not recorded, including unemployed ..	22	4·29
Total ..	512	100

'Shopkeepers' mean the small village shopkeepers and other business men associated with village life. 'Artisans and

Craftsmen' include such village occupations as those of carpenters, weavers, barbers, washermen, etc. 'Hired Labourers' form a small but separate category in the villages made up of those who do not own any land of their own. They are mostly employed by others on a seasonal basis, usually come from the lowest social strata and change their work frequently. The 'Domestic Servants' mostly come from the urban part of the sample, where they are usually employed in families with whom they reside all the 24 hours. In the rural areas there are very few domestic servants, if any at all.

It will be seen that farmers constitute the major portion of our sample. This correctly reflects the pattern of occupations in the villages and among the illiterate population, as farming is the major occupation of these people. The proportion of the other occupations is practically the same in our sample as is to be found in the general population.

Communitywise Distribution. The distribution communitywise is given below. We have here the data for all except a very few.

Community	Number	Percentage of those recorded
Brahmin	62	14·62
Kshattriya	41	9·70
Vaishya..	23	5·42
Muslim	29	6·84
All the above combined i.e. non-Backward communities.	155	36·58
Backward communities	269	63·42
Total Recorded ..	424	100

The Backward communities include the following: Ahir, Nai, Dobi, Barhai, Kumhar, Kurmi, Chamar, Pasi and Bhangi. Some are more backward than others and the most backward are

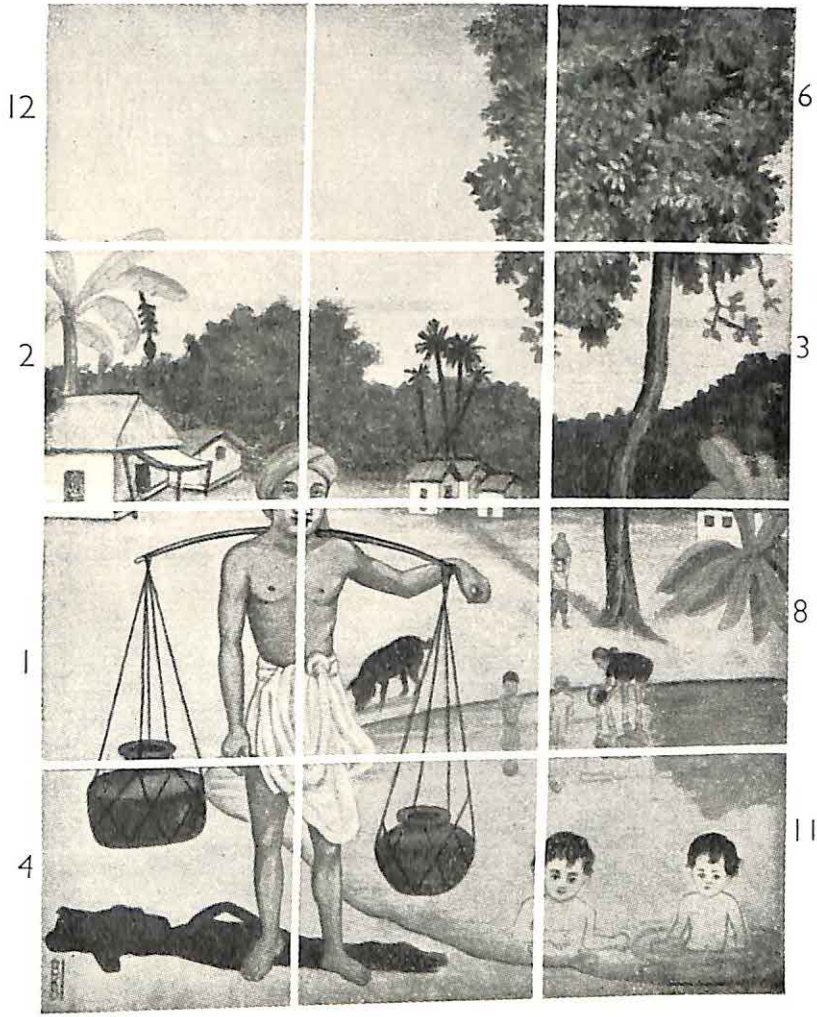
often called 'Harijans' nowadays, after the name given to them by Mahatma Gandhi.

The proportion of these communities represented in our sample is practically the same as in the general illiterate population. An important feature to be noted here is that although the backward communities constitute a large proportion of illiterates, illiteracy is not a feature of backward communities alone. About 40 per cent (i.e. something less than half) of the illiterates come from the non-backward communities, illiteracy, where it exists, being quite general and not confined to any groups on any particular basis.

We may, on the basis of the above evidence, conclude that our sample is fairly representative of the total illiterate population from the geographical, occupational and social points of view.

The Literate Group

The sampling for the literate group did not present much difficulty, being based on the representative schools and geographical areas. In these schools and areas, complete groups coming under our category were tested. In the urban area, three schools were selected from the city of Allahabad itself where testing was easy. One of these was above the average, the other average, and the third somewhat below the average according to the standards prevailing in Allahabad. It was however felt that Allahabad standards would perhaps be higher than those of the other parts of the State, as Allahabad is generally accepted to be the intellectual centre of the State, being the seat of an old and well established university and the headquarters of the State High Court and several learned bodies. Four other urban areas, geographically well distributed (including one—namely Garhwal —in the heart of the northern Himalayas) were therefore included, as also one typical rural area in the plains—Sultanpur, by name.



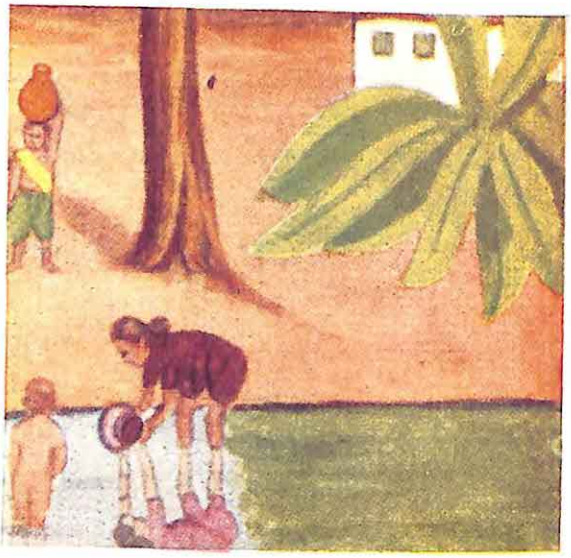
PICTURE CONSTRUCTION

Sub-test 5. Original 11″ × 8¼″

Middle row, from top to bottom, numbered 9, 5, 7, 10

PICTURE CONSTRUCTION

Parts of Sub-tests 2 and 5 in actual size and colour



The geographical distribution of the sample was thus as under :

Area	Number	Percentage of the whole
Boys' School, Allahabad	100	15·58
Basic Middle School, Allahabad	86	13·40
Gorakhpur, Urban	35	5·45
Garhwal, Urban	46	7·17
Jhansi, Urban	66	10·28
Sultanpur, Rural	64	9·97
Govt. Inter. College, Allahabad	125	19·47
Bareilly, Urban	120	18·69
Total ..	642	100

Occupational Distribution

Occupation	Number	Percentage of the whole group
Higher Professions	135	21·03
Middle Class Service	227	35·36
Lower Class Service	47	7·32
Business	83	12·93
Agriculture	92	14·33
Not Recorded	58	9·03
Total ..	642	100

The 'Higher Professions' include Lawyers, Doctors, Engineers, University Teachers and high Government servants and their income would be above Rs 300 p.m.

'Middle Class Service', which is quite a numerous class among the literate population, includes clerks and other office workers in Government and other concerns, railway employees, mechanics and other employees in engineering firms, and

employees (including teachers) of other public bodies such as the Municipalities. Their range of income is roughly between Rs 100 and Rs 300 p.m.

The 'Lower Class Service' group consists of those whose services are manual rather than mental and it includes the labour class of the cities. The income of this group is below Rs 100 p.m.

The 'Business' group includes all who carry on business of their own. In ordinary-sized Indian cities they form a part of the middle class.

In the 'Agriculture' group are included those who live upon their income from the land, generally called zamindars (landlords). It also includes farmers of the countryside.

In the 'Not Recorded' group, we have included orphans and those whose parents were unemployed.

The percentages show that our sample represents a fair cross-section of the literate population.

Communitywise Distribution

Community	Number	Percentage of the whole
Brahmin	139	21·65
Kshattriya (including Khattri)	62	9·66
Kayastha	122	19·00
Vaishya	42	6·54
Muslim	120	18·69
Christian and Anglo-Indian	65	10·12
Backward Communities	31	4·83
Others	61	9·50
Total ..	642	100

The heading 'Others' includes those whose communities could not be ascertained, as also a few Parsis, Sikhs and Jains.

The percentages would indicate that our sample is fairly representative of the general literate population on the basis of communities.

It would thus appear that our sample is fairly representative of the general population from the geographical, occupational and social points of view.

Some General Remarks about Testing

It remains for us now only to record some general experiences and problems of testing, particularly in regard to the rural areas. Two of them now stand out in particular: the difficulty of communication and the attitude of the villager.

Communication was at times quite difficult and often something of an adventure though not always an unpleasant one. The reason for this is that although the bigger cities and towns are well connected by railways and other means including air, the countryside is not so. Communication is only through roads which are neither numerous nor always of a very high order. Public transport service, especially motor service, is not very common, although in this respect much improvement has taken place during the three or four years since the completion of this study. Very often, therefore, the means of communication was a horse-driven carriage, particularly in the last stages of one's journey to remoter villages. Consequently it took much more time to reach a village 30 or 40 miles from a town, than to travel from one town to another very much farther apart; for example, 24 hours were required to reach a village only 40 miles from the city of Agra. Travelling had sometimes its dangers, as this work was being carried on at a time of great political upheaval (1947). A great relieving feature, however, in all such travelling was the never-failing hospitality of the people of the countryside, it being always possible to spend a night with some unknown 'friend' whenever necessity arose.

The attitude of the villager towards this work, or indeed towards any outside activity, needs careful understanding. The villager is not hostile to outside activities or agencies as such; he is only sceptical, which perhaps only shows he understands his own affairs in his own way and judges everything else on merit. After long experience, he has perhaps correctly realized that things do not always change for the better. He is, therefore, suspicious of strangers; but to a friend properly introduced, recognized and accepted, his warmth is unbounded. The village is one family in the truest sense of the word, where everybody knows everybody and all experiences are equally shared.

The key to successful testing, or indeed any other activity, in the village is to enter into the village life completely; to become one of the village as far as possible. Actual residence in the village itself all the 24 hours during the period of work is therefore a great advantage. If one has some resident of the village as one's friend to start with, it is very helpful. When this confidence of the village has once been obtained, the tester can carry on his work with as much scientific rigour in a village as anywhere else. For in the last analysis the emotional attitude of the villager is very much like that of a child. He is curious as well as suspicious. But when once his confidence has been obtained and a rapport established, almost any activity can be carried on in his midst just as a teacher can carry on in a class in any way he likes when once he has 'cleared the decks' with his boys. A proper attitude and an initial good start are the necessary requisites. Satisfying the curiosity of the village people in matters which do not conflict with the principles of testing often does the trick. I can recall one particularly interesting incident in this connexion. In one particular village, when I arrived, I found some of the adults conspicuously hostile. When I started giving a test to a boy some of them collected round and tried to decry the whole testing, considering it to be of a farcical nature. In particular one of them was loud in proclaiming that the whole affair was child's play. It was the Kohs' Block

Design Test I happened to be administering at the moment, and he seemed to consider the designs as quite simple and plain. I knew that this adult did not come under the category of my subjects but also, knowing that no harm would be done by letting him try the test as the Kohs' test goes right up to the adult stage, I stopped my regular testing and politely asked him to take the subject's place and try the designs himself if he thought them all to be so trivial. In a spirit of bravado he consented ; but, when he soon got stuck with a design, much to the amusement of the other onlookers and to his own great chagrin, the battle for me was won. They all realized it was not all just a joke. Such occasions, if tactfully handled, give great help and impetus to the work.

V. A FACTORIAL ANALYSIS OF THE TESTS

The Group

A factorial analysis of the tests of the battery was carried out in order to identify the psychological factors assessed. For the purpose of factorial analysis, a group of 100 literate subjects (students of the Boys' School, Allahabad) was also given the Terman-Merrill New Revised Stanford-Binet Tests of Intelligence (Form L). This, it was considered, would provide a very sound background for the evaluation and analysis of our battery and would be much better than dependence upon the teacher's opinion alone, although the latter has also been examined in a later chapter in connexion with the validity of the battery. The Binet tests were given the same day as the battery, usually after it, after giving the subject a rest of a quarter to half an hour in between. One boy was tested every day with the battery and the Binet tests, usually in the mornings.

The possibility of using the Stanford-Binet Tests arose from the circumstance that we have, or at least used to have, what are known as European schools, where the medium of instruction was English throughout and which followed the same curriculum as schools in Britain. The boys in these schools used to sit for the Cambridge examinations, and their papers were all set in Britain. Hindi or Urdu, the mother-tongue of the Indian student in general, was taught to them as a second language. All the teachers used to be Europeans, or at least Anglo-Indians. The whole atmosphere of the school approached that of a British school very closely. The pupils in these schools used to be mostly of mixed European and Indian descent, whose language at home was also English. With these something like one-half to one-third of the total used to be boys of pure Indian descent. The Indian families from which these boys came belonged to the most

select classes and were much more anglicized than an average educated Indian family. It will thus be seen that both the school and the home environment of these boys was such that the Stanford-Binet tests could be well applied, and in fact we found them to work very well indeed.

The distribution of the Binet IQ's of the boys of this group, as we found them, is given below :

IQ Class interval	Frequency
145 and above	1
140 – 144	4
135 – 139	2
130 – 134	3
125 – 129	6
120 – 124	6
115 – 119	6
110 – 114	7
105 – 109	13
100 – 104	14
95 – 99	19
90 – 94	11
85 – 89	5
80 – 84	1
75 – 79	1
70 – 74	0
Below 70	1
Total	100

Mean IQ = 107·0

S.D. = 15·7

The group was therefore a representative one, but rather above the average.

The distributions, for this group, of the raw scores of the different tests of the battery are given under:

Kohs'

Scores	Frequency
16 and above	8
14 – 15	13
12 – 13	15
10 – 11	15
8 – 9	17
6 – 7	17
4 – 5	8
2 – 3	6
0 – 1	1
Total	100

Passalong

Scores	Frequency
16 and above	3
14 – 15	15
12 – 13	8
10 – 11	22
8 – 9	29
6 – 7	18
4 – 5	5
2 – 3	0
Total	100

Patterns

Scores	Frequency
16 and above	2
14 – 15	7
12 – 13	15
10 – 11	33
8 – 9	22
6 – 7	17
4 – 5	3
2 – 3	1
Total	100

Memory

Scores	Frequency
15	5
14	9
13	18
12	28
11	20
10	15
9	3
8	2
Total	100

Pictures

Scores	Frequency
15	5
14	12
13	11
12	17
11	20
10	8
9	13
8	8
7	4
6	2
Total	100

As these scores were correlated with Binet Mental Ages, and *not* the IQ's, the distribution of the Binet M.A. of the group is given below :

Binet M.A.

Binet M.A.	Frequency
20 —	3
19 —	3
18 —	8
17 —	3
16 —	12
15 —	13
14 —	21
13 —	14
12 —	16
11 —	5
10 —	2
Total	100

Correlations

It will be observed that all the above distributions are normal distributions, and thus the calculation of the intercorrelation between the scores of the different tests is valid. Pearson's Product-moment Coefficient of Correlation by Grouping and Diagonal Adding was computed in each case. Appropriate checks were applied at all stages of computation, and here particularly that of diagonal adding in the other direction[26] which is that $C + C' = 2(A + B)$.

As the group consisted of boys of differing chronological ages, and as accurate chronological ages of this group were available (unlike the general school and other population in India, which will be discussed in a later chapter on the standardization of the battery), it was possible to partial out the effect of age on the intercorrelations of the tests. The intercorrelations between all the above tests and the chronological age were therefore calculated, again by the method of Grouping and Diagonal Adding. The distribution of the group for chronological age is given below:

Chronological age		Frequency
17 *years*	6 *months*	8
17	0	6
16	6	9
16	0	7
15	6	8
15	0	8
14	6	12
14	0	7
13	6	8
13	0	9
12	6	4
12	0	2
11	6	3
11	0	4
10	6	5
Total		100

TABLE 1

FULL CORRELATIONS

	Age	Binet M.A.	Kohs'	Passalong	Patterns	Memory	Pictures
	a	1	2	3	4	5	6
Age .. .. *a*	1·0000	0·4312	0·4407	0·3264	0·2228	0·0937	0·3383
Binet M.A. .. 1	0·4312	1·0000	0·5695	0·4123	0·4621	0·3931	0·4224
Kohs' 2	0·4407	0·5695	1·0000	0·4871	0·5346	0·1845	0·4496
Passalong .. 3	0·3264	0·4123	0·4871	1·0000	0·4284	0·2308	0·4379
Patterns .. 4	0·2228	0·4621	0·5346	0·4284	1·0000	0·1136	0·3622
Memory .. 5	0·0937	0·3931	0·1845	0·2308	0·1136	1·0000	0·1635
Pictures .. 6	0·3383	0·4224	0·4496	0·4379	0·3622	0·1635	1·0000

The full correlations between chronological age (called Age), Binet M.A., Kohs', Passalong, Patterns, Memory and Pictures Tests, hereinafter referred to as, a, 1, 2, 3, 4, 5, 6 respectively, are given in Table 1. The standard error of the correlation coefficient, $r = 0$, is 0·10.

From the above, partial correlations for constant age were calculated by the formula[27]

$$r_{12a} = \frac{r_{12} - r_{1a}r_{2a}}{(1 - r_{1a}^2)^{\frac{1}{2}} \quad (1 - r_{2a}^2)^{\frac{1}{2}}}$$

This was done by one pivotal condensation with age in the top row and first column, followed by normalization.[28] The partial correlations for constant age between the variates 1 (Binet M.A.), 2 (Kohs'), 3 (Passalong), 4 (Patterns), 5 (Memory), and 6 (Pictures), are given in Table 2.

Factor Analysis

This correlation-matrix was analysed factorially into orthogonal factors by Thurstone's Centroid method[29] with guessed communalities. The communalities inserted initially for each test were the highest correlations in each column or row. The first factor loadings were then obtained by the usual method, and were as given below:

Test	Loadings for Factor I
Binet 1	0·6802
Kohs' 2	0·6792
Passalong 3	0·5961
Patterns 4	0·6283
Memory 5	0·3969
Pictures 6	0·5326

The first residual matrix was then obtained, and the residuals were tested for significance, by McNemar's formula, namely that factors may be taken out[30] until the quantity σ_1 reaches

TABLE 2

PARTIAL CORRELATIONS FOR CONSTANT AGE

	Binet M.A.	Kohs'	Passalong	Patterns	Memory	Pictures
	1	2	3	4	5	6
Binet M.A. 1	1·0000	0·4685	0·3184	0·4161	0·3926	0·3256
Kohs' 2	0·4685	1·0000	0·4046	0·4986	0·1602	0·3558
Passalong 3	0·3184	0·4046	1·0000	0·3859	0·2127	0·3682
Patterns 4	0·4161	0·4986	0·3859	1·0000	0·0955	0·3127
Memory 5	0·3926	0·1602	0·2127	0·0955	1·0000	0·1406
Pictures 6	0·3256	0·3558	0·3682	0·3127	0·1406	1·0000

or falls below $1/\sqrt{N}$ (where N is the size of the sample), the quantity σ_1 being defined as $\sigma_s/(1 - M_{h^2})$ where σ_s = st. dev. of the residuals after s factors and M_{h^2} = mean communality for s factors.

We had, in our case, $\sigma_s = 0{\cdot}0701$ and $M_{h^2} = 0{\cdot}3525$, so that

$$\frac{\sigma_s}{1 - M_{h^2}} = \frac{0{\cdot}0701}{0{\cdot}6474} = 0{\cdot}1083 > N^{-\frac{1}{2}}$$

N being equal to 100 in our case.

We could therefore extract a second factor, but no further.

In order to extract a second factor, we changed the signs of the first and fifth rows and columns of the residual matrix, and again put in guessed communalities, namely the highest residuals irrespective of sign in each column or row. The second factor loadings were then obtained, and we stopped the further extraction of factors.

The loadings for Factor I and Factor II (with proper signs inserted), together with communalities, are given below:

	Factor I	Factor II	h^2 (communality)
Binet 1	0·6802	−0·2563	0·5284
Kohs' 2	0·6792	0·1904	0·4976
Passalong .. 3	0·5961	0·1781	0·3871
Patterns 4	0·6283	0·2607	0·4628
Memory .. 5	0·3969	−0·4349	0·3467
Pictures 6	0·5326	0·1377	0·3026

Iterations

A comparison of the communalities for each test, as we had put them in and as they came out, made it evident that the analysis was not yet stable and that our guessed communalities had been far from the true values in many cases. Iterations therefore had to be carried out to approximate to the true values of the communalities as far as possible. This was specially necessary because

the number of tests included in our analysis was small, and wrong communalities were therefore liable to make appreciable differences in our loadings. The usual practice in iteration is to use that value of the communality (for a test) which has resulted from the previous iteration, and thus to continue the iterations till the values do not show further marked change, this indicating a near approximation to the true values. This often entails numerous iterations. In order to reduce the number of iterations, if possible, we followed the device* of putting in a value for the communality which a comparison of the value as put in an iteration, and as it was obtained from it, suggested to be a near approximation to the true value. We were able to reach approximately true values in this way by means of three iterations (including the first original one which we have already reported). However, we did a last fourth iteration using the values obtained from the third one, in order to get the final factor loadings of our tests. The results of all four iterations, with communalities put in and as they came out, are given below :

	First		*Second*	
	Communality put in	Communality obtained	Communality put in	Communality obtained
Binet 1	0·4685	0·5284	0·60	0·6089
Kohs' 2	0·4987	0·4976	0·50	0·5179
Passalong 3	0·4046	0·3871	0·36	0·3964
Patterns 4	0·4987	0·4628	0·40	0·4423
Memory 5	0·3926	0·3467	0·30	0·2636
Pictures 6	0·3682	0·3026	0·20	0·2707

* This suggestion was due to Mr W. G. Emmett, Moray House, Edinburgh.

	Third		*Fourth*	
	Communality put in	Communality obtained	Communality put in	Communality obtained
Binet 1	0·60	0·6206	0·6206	0·6311
Kohs' 2	0·51	0·5004	0·5004	0·4970
Passalong 3	0·40	0·3880	0·3880	0·3836
Patterns 4	0·42	0·4195	0·4195	0·4211
Memory 5	0·24	0·2606	0·2606	0·2711
Pictures 6	0·28	0·2771	0·2771	0·2770

The final factor loadings from the fourth iteration are as under (with proper signs):

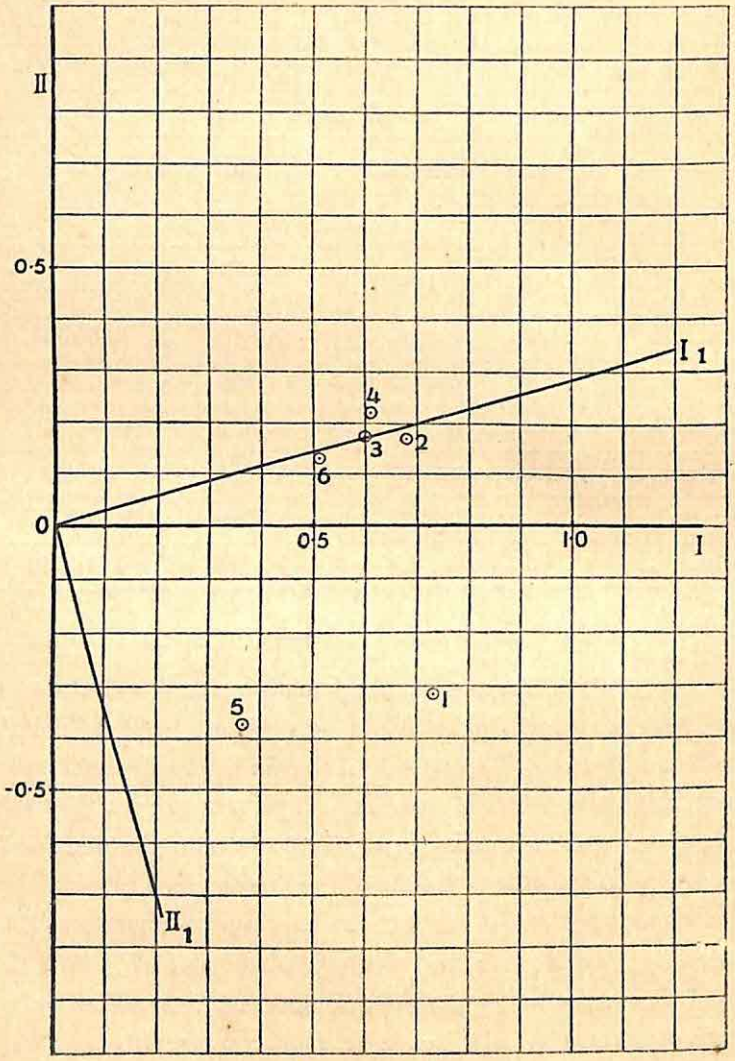
	I	II	h^2 (communality)
Binet 1	0·7284	—0·3170	0·6311
Kohs' 2	0·6843	0·1695	0·4970
Passalong .. 3	0·5954	0·1705	0·3836
Patterns 4	0·6099	0·2215	0·4211
Memory 5	0·3617	—0·3744	0·2711
Pictures 6	0·5101	0·1298	0·2770

Rotation of Axes and Interpretation of Factors

The centroid factors are only mathematical in nature and have no clear psychological meaning until rotated into suitable positions. Plotting the positions of the six tests with reference to co-ordinate axes I and II (see graph 1), it was evident that Tests 2, 3, 4 and 6 formed one cluster, Test 1 was in the middle and Test 5 lay to the other extreme of the factor space.

It was therefore clear that the most suitable rotation of the axes was to rotate I to pass through the cluster of Tests 2, 3, 4 and 6 (it was actually passed through Test 3), and to have II again as orthogonal to I, but in a direction reverse to its original, so as to make the signs of factor loadings of Tests 1 and 5 in II

also positive. This conforms to the usual practice in rotation, namely not to have any negative factor loadings and to have as many zero factor loadings as possible. In our case the clustering together of Tests 2, 3, 4 and 6 was very suggestive as all these are tests of a practical performance nature given with the help of concrete materials.



1. Rotation of Axes

The loadings of the rotated factors I_1 and II_1 for the different tests are as given below :

	I_1	II_1
Binet 1	0·6129	0·5053
Kohs' 2	0·7045	0·0254
Passalong 3	0·6193	0·0000
Patterns 4	0·6474	—0·0448
Memory 5	0·2446	0·4596
Pictures 6	0·5261	0·0153

The Nature of the Factors

The examination of the above loadings of the different tests of the battery (2, 3, 4, 5 and 6) and of the Binet Test (1), makes the nature of both the factors fairly clear. Factor I_1 is a general factor mostly of the nature of *g*, as the loadings of the Binet, Kohs' and Memory tests would particularly indicate, the loadings of the Binet and Kohs' tests being among the highest, and that of the Memory Test the lowest. It would appear to be a combination of a *g* factor with a factor most characteristic of Tests 2, 3, 4 and 6 which might obviously be of a spatial nature and which our analysis has failed to bring out firstly because of the small number of tests included in our analysis (6 tests can *at the most* give 3 factors) and also because of the small size of our sample which makes the second residual matrix insignificant. (Our analysis obviously was not taken up from the point of view of a finer classification of all the different factors, but for obtaining a workable hypothesis of what our battery measured. We shall refer to this point again presently.) Also, the factor I_1 seems[31] to be including that characteristic of Binet tests which is similar to the Performance tests, and excluding that which is peculiar to it, namely the Verbal factor, for the Binet test characteristically lies in the centre of the quadrant formed by the axes I_1 and II_1.

The second factor II_1 is clearly a Memory-Verbal factor since it has loadings only on the Memory and Binet tests.

The above factor analysis would justify us in concluding that our battery of tests assesses, among other factors, a factor of a general nature most nearly approximated by Spearman's g factor in intelligence in combination with a spatial factor.

A Third Factor—Spatial Ability

Although our second residual matrix was not statistically significant, we decided to analyse it further by the usual centroid method, to see if any suggestion for a third factor, especially of a spatial nature, was forthcoming. For this, we employed the second residual matrix as obtained in our fourth iteration. The signs of Tests 2, 4 and 5 (or alternatively, which is the same thing, of 1, 3 and 6) were changed, and the highest residual, irrespective of sign, in each row or column was now used as the communality for the test. The third factor loadings, with correct signs inserted, were as follows :

		Factor III
Binet	1	— 0·1687
Kohs'	2	— 0·1683
Passalong	3	0·2520
Patterns	4	— 0·1975
Memory	5	0·1688
Pictures	6	0·1263

The above loadings, particularly the grouping of the tests according to signs, does suggest a spatial factor of the nature of k (not F) as Kohs' and Patterns have obviously a spatial component, and the Binet tests are usually known to have a weak component of this nature as some of its tests, such as Paper-cutting I and II and the Enclosed Box Problem, are of this nature. It is the loading of the Passalong test alone which would appear to be a disturbing feature unless we suppose that the

Passalong test alone measures a separate F factor and that it has no appreciable loading on a k factor as distinct from F [32]. As it is, we do not present the above evidence to indicate any conclusions about the nature of this factor, as our residual matrix is, in any case, statistically insignificant, but to point out that there is a suggestion of a third factor, probably of the nature of k, in our battery of tests.

Keeping the axis II_1 fixed, we rotated the axes I_1 and III to obtain the rotated factors I_2 and III_1 by passing I_1 through the Passalong test to obtain I_2, and again having III_1 orthogonal to it but in the reversed direction. This gave us both a maximum number of zero loadings in III_1 and also made all the loadings of III_1 positive. I_2 and III_1 could then, perhaps, be taken as the g and k factors respectively and are given in the table below, although we have made no use of this part of the analysis because of its general uncertainty.

	Factor I_2	Factor III_1
Binet 1	0·5041	0·3873
Kohs' 2	0·5891	0·4214
Passalong 3	0·6686	0·0000
Patterns 4	0·5251	0·4270
Memory 5	0·2901	— 0·0641
Pictures 6	0·5349	0·0813

Low Communalities

A remark on the low communalities of some of our tests, particularly Memory and Pictures, may be added here in closing. The low communalities of these tests in our analysis, we consider, are primarily due to the absence of tests of a similar nature in the battery. From the point of view of the construction of the battery itself, it is perhaps not undesirable, because we do not wish to repeat tests which are of a very similar nature, and therefore, although correlating highly between themselves, do

not necessarily add to our information about the ability of the subject tested. But in a factor analysis this leads to a very large part of the communality of such tests remaining unexplored. For the purpose of factor analysis, when we wish to identify primary factors as such, a number of similar tests are always desirable and are usually included in such an analysis. This was not the purpose of the analysis in our case. It may however be pointed out that the Memory test correlated best with the Binet test which has a Memory component, and that the correlation of the Pictures test with one of its own kind would probably be higher than what has been obtained with the other tests of the battery.

VI. THE STANDARDIZATION OF THE BATTERY

The battery has been standardized under three separate heads, namely, (*a*) for the literate group, based on the performance of the literate group alone, (*b*) for the illiterate group, based on the performance of the illiterate group alone, and (*c*) for the literate group based on the performance of the literate but to give the best estimate of practical intelligence—the factor I_1 (a combination of *g* and *k*), as obtained in the analysis in the previous chapter.

Recording of Age

Since our age-group is from 11 to 16 years, there is quite a wide variation of age which had to be taken into account in the standardization. The recording of the correct age has been a troublesome matter in all psychological and educational investigations in India. This is true for literates as well as for illiterates. In the case of literate children the trouble arises because the ages recorded in the school register officially are often *not* the correct ages, parents very often getting the ages of their children recorded one year, or even more than a year, wrong. The correct ages in such cases are generally in excess of the officially recorded ages, but there is no uniformity in this matter, which is the greatest stumbling-block, for if the excess was uniform in all cases it could be allowed for. The investigations done so far have been made on various assumptions. One of them is to base the standardization on the officially recorded ages as such. Now, although such a procedure may be justified from the point of view of the group *as a whole*, it is likely to do severe injustice and create great error in *individual* cases.

We have tried to meet this situation in two ways. First, we have made our records of age correct to the *nearest year* only and have *not* gone into months. Secondly, we have two columns

for the record of age in our Record forms for recording the details of the subject and his performance on the battery, namely, (1) age from official records and (2) estimated age. The testers were instructed to make a note in the second column whenever they felt any discrepancy between the official age and the apparent age of the subject. For example, if the official age of a subject reading in Class IX (i.e. one standard below the Matriculation) was recorded as 11 years, which is at least 3 years below the usual age, an attempt was made to investigate the matter further. The boy himself was questioned, and his general appearance judged. Gross inaccuracies of age were thus, it is hoped, eliminated; and the standardization being based on the nearest year makes the age allowance, it is hoped, fairly equitable.

The difficulty in the case of illiterates arises from their general lack of a time sense. Usually no accurate records are available. The age correct to the nearest year can however be easily ascertained and will not be far wrong, especially if the tester has some contact with the village, without which, as we have already seen, testing itself will not be feasible. So the problem of age in the case of illiterates also can be fairly well met.

We have worked with ages to the nearest year in the case of both literates and illiterates. In the final tables however we have given scores or IQ's, as the case may be, corresponding to the intervening half-years of age also. This has been done by means of interpolation, and in the hope that as more accurate records of age may be possible in the future, these additional figures may prove useful. Of course, revision of norms will ultimately be necessary when such accurate records of age become fully available.

Method of Standardization

The standardization has been done on the basis of the percentile ranks of individuals *within* their age-groups, but the final results have been expressed in terms of ratios called IQ's. This we have done to conform to the usual practice of expressing

mental ratios in terms of IQ's or at least calling them so. The IQ's obtained according to our present procedure are therefore not *exactly* the same as the ratio of mental age to chronological age, but are very nearly comparable with them.

An important point about the IQ tables given for the literate and illiterate groups must be carefully noted. As already pointed out, we have based the standardizations for these groups separately on the basis of the performance of their *own* groups alone. This we did, because we found the performance of the two groups on the battery to be significantly different. The same IQ (for example, 100), therefore does not denote the same level of performance with respect to the battery of tests in both cases, the performance of the illiterate group being consistently lower. The standardization of the battery for the illiterate group on the basis of its own results was however later found to be further justified when we compared our IQ's with the general opinion about the intelligence of these boys held in the village. We shall supply this information on the reliability and validity of the tests in the next chapter, when we also discuss the general problem of the performance of the literate and illiterate groups. This, as we had anticipated, has touched upon one of the most fundamental aspects of mental testing.

The actual method of standardization followed is due to Thomson,[33] for his was the only method applicable to our data, because of a large variation of age-range and of the uncertainty of the nature of the growth curve therein for our groups. Our method thus was to calculate the 5th, 16th, 50th, 84th and 95th percentile scores for the distributions of each age-group, 11 years, 12 years, 13 years, 14 years, 15 years and 16 years, separately, and then to plot these percentile scores (see Graph 7) and obtain the various percentile lines. We then examined these percentile lines to see what type of curve should be fitted to them. For the illiterate group we found it best to fit straight lines throughout for all percentile lines, but for the literate group we fitted straight lines from 11 to 15 years, and thereafter

continued a straight line by means of a curve which was tangential to it but had a tendency to become horizontal. This is discussed later in some detail. From these lines of best fit, the correspondence between raw scores and IQ's was established in every case, by means of the familiar procedure of equating the 5th percentile score to 75 IQ, 16th percentile score to 85 IQ, 50th percentile score to 100 IQ, 84th percentile score to 115 IQ, and 95th percentile score to 125 IQ, thus working on a standard deviation of 15 IQ points. From these values, further subdivisions of IQ values were obtained by the method of interpolation and extrapolation. The tables of norms in each case were calculated to one decimal point of the raw scores, and from these tables of norms, conversion tables were obtained from which IQ's for any given raw score for any age can be read off directly. The conversion tables are in terms of whole numbers only and are meant to be put into the hands of those who make use of the battery for the purpose of evaluating a child's IQ..

Standardization Data

The standardization data are presented below under separate heads; (*a*) for the literate group with unweighted raw scores, (*b*) for the illiterate group with unweighted raw scores, and (*c*) for the literate group with weighted scores to obtain the best prediction for factor I_1.

(*a*) *For the Literate Group*

The percentile scores for the different age-groups are given in Table 3, which also contains the distributions of the scores for the different age-groups. From these, the percentile lines shown in Graph 7 have been plotted. It was clear from the graph that straight lines would be the best fit from 11 to 15 years of age. The percentile scores for the 16-year age-group show an actual *decline* in three instances. This decline was due to the 'creaming' effect in the 16-year age-group that we had been able to test; for we had not tested boys in higher colleges and

TABLE 3

LITERATE GROUP: DISTRIBUTION OF RAW SCORES (n = 642)

Scores	11 years		12 years		13 years		14 years		15 years		16 years		Totals
	f	cum. f	f	cum. f	f	cum. f	f	cum. f	f	cum. f	f	cum. f	f
80 – ..	..		..		..		..		1	89	1	109	2
75 – 79 ..	..		..		..		..		1	88	0	108	1
70 – 74 ..	..		..		1	134	4	122	3	87	4	108	12
65 – 69 ..	..		1	102	1	133	5	118	6	84	11	104	24
60 – 64 ..	1	86	1	101	5	132	9	113	10	78	17	93	43
55 – 59 ..	1	85	6	100	14	127	10	104	18	68	18	76	67
50 – 54 ..	4	84	10	94	24	113	31	94	23	50	18	58	110
45 – 49 ..	13	80	19	84	32	89	17	63	12	27	12	40	105
40 – 44 ..	14	67	24	65	19	57	17	46	9	15	12	28	95
35 – 39 ..	21	53	17	41	14	38	7	29	4	6	10	16	73
30 – 34 ..	16	32	10	24	10	24	10	22	0	2	4	6	50
25 – 29 ..	11	16	8	14	11	14	11	12	2	2	2	2	45
20 – 24 ..	3	5	5	6	3	3	1	1	..		..		12
15 – 19 ..	2	2	1	1	..		..		..		..		3
Totals ..	86		102		134		122		89		109		642

Percentiles	%	Score	%	Score	%	Score	%	Score	%	Score	%	Score	
95	81·7	51·6	96·9	56·9	127·3	59·8	115·9	67·4	84·6	70·5	103·5	69·3	
84	72·2	46·5	85·7	50·4	112·6	54·4	102·5	58·8	74·8	62·9	91·6	64·1	
50	43·0	37·1	51·0	41·6	67·0	46·1	61·0	48·9	44·5	53·3	54·5	53·5	
16	13·8	28·5	16·3	30·7	21·4	33·2	19·5	33·3	14·2	44·0	17·4	40·1	
5	4·3	23·3	5·1	23·5	6·7	26·2	6·1	26·3	4·4	37·5	5·5	33·9	

universities, and many of the more brilliant had already left the high schools at 16 to join colleges. But although we could not expect an actual decline after 15 years, we had equally no evidence to suggest if the rate of growth would be maintained at the same linear rate after 15 years, as between 11 and 15 years. Usually it is considered that mental growth after 15 years begins to show signs of ceasing. On this assumption, we found it most defensible to extend the straight lines of best-calculated fit for 11 to 15 years by means of curves, in such a way that the curves were tangential to the straight lines at the point of start, and became more and more horizontal as they moved away from it. This extension was done by graphical means only, and as an interval of 1 year only is involved, it is considered that no serious inaccuracy can be involved in this procedure.

The straight lines of best fit from 11 to 15 years have been calculated by giving due weights to numbers in each age-group. Their slope, m, is given by the formula :

$$m = \frac{\Sigma a.\Sigma s - n\Sigma as}{[\Sigma a]^2 - n\Sigma a^2}$$

where n = total number in the group (= 533)

Σa = total age of the group computed with the varying numbers in each age-group.

Σs = total score of the group computed with the varying numbers in each age-group.

Σas = total age multiplied by the score for the group computed with the varying numbers in each age-group.

and Σa^2 = total squares of the ages in the group, again computed with the varying numbers in each age-group.

The equations to the straight lines for the various percentiles were as follows (with $a = 0$ at 11 years) :

5 percentile .. .. $s = 3{\cdot}07a + 21{\cdot}36$

16 percentile .. .. $s = 3{\cdot}23a + 27{\cdot}44$

50 percentile .. .. $s = 3{\cdot}95a + 37{\cdot}50$

84 percentile .. .. $s = 4{\cdot}13a + 46{\cdot}34$

95 percentile .. .. $s = 4{\cdot}87a + 51{\cdot}46$

The scores for the different ages were as follows:

5 percentile	s_{11}	= 21·36
	s_{12}	= 24·43
	s_{13}	= 27·50
	s_{14}	= 30·57
	s_{15}	= 33·64
16 percentile	s_{11}	= 27·44
	s_{12}	= 30·67
	s_{13}	= 33·90
	s_{14}	= 37·13
	s_{15}	= 40·36
50 percentile	s_{11}	= 37·50
	s_{12}	= 41·45
	s_{13}	= 45·40
	s_{14}	= 49·35
	s_{15}	= 53·30
84 percentile	s_{11}	= 46·34
	s_{12}	= 50·47
	s_{13}	= 54·60
	s_{14}	= 58·73
	s_{15}	= 62·86
and finally, 95 percentile ..	s_{11}	= 51·46
	s_{12}	= 56·33
	s_{13}	= 61·20
	s_{14}	= 66·07
	s_{15}	= 70·94

From the conversion table thus prepared (Table 15) the distribution of IQ's for the whole group was found to be as follows :

IQ's	Frequency
130 and above	14
125 – 129	14
120 – 124	27
115 – 119	44
110 – 114	52
105 – 109	75
100 – 104	101
95 – 99	97
90 – 94	64
85 – 89	53
80 – 84	36
75 – 79	24
70 – 74	24
Below 70	17
Total	642

The Mean was found to be 99·37, and the Standard Deviation 14·62 IQ points.

(*b*) *For the Illiterate Group*

The distribution of raw scores for different age-groups and the different percentile values are given in Table 4. The percentile lines are given in Graph 7 (p. 88). As there was no suggestion of any decrease in percentile values from 15 years to 16 years (on the other hand, very often the rise is even sharper than before), straight lines were fitted to these scores from 11 years to 16 years. The equations (with $a = 0$ at 11 years) were as follows :

5 percentile .. .. $s = 2{\cdot}65a + 10{\cdot}0$

16 percentile .. .. $s = 2{\cdot}30a + 14{\cdot}6$

TABLE 4

ILLITERATE GROUP: DISTRIBUTION OF RAW SCORES (n = 512)

Scores	11 years		12 years		13 years		14 years		15 years		16 years		Totals
	f	cum. f	f	cum. f	f	cum. f	f	cum. f	f	cum. f	f	cum. f	f
55 –	..		..		..		..		..		..		..
50 – 54 ..	..		1	98	..		..		2	78	1	56	4
45 – 49 ..	..		1	97	1	112	3	90	1	76	2	55	8
40 – 44 ..	1	78	1	96	2	111	3	87	10	75	12	53	29
35 – 39 ..	8	77	8	95	8	109	15	84	13	65	16	41	68
30 – 34 ..	8	69	12	87	24	101	16	69	16	52	10	25	86
25 – 29 ..	11	61	23	75	33	77	25	53	19	36	12	15	123
20 – 24 ..	21	50	25	52	32	44	19	28	15	17	3	3	115
14 – 19 ..	17	29	19	27	9	12	9	9	1	2	..		55
10 – 14 ..	10	12	6	8	3	3	..		0	1	..		19
5 – 9 ..	2	2	2	2	..		..		1	1	..		5
Totals ..	78		98		112		90		78		56		512

Percentiles	%	Score	%	Score	%	Score	%	Score	%	Score	%	Score
95	74·1	37·7	93·1	38·3	106·4	37·9	85·5	42·0	74·1	44·1	53·2	45·0
84	65·5	32·3	82·3	32·5	94·1	33·1	75·6	36·7	65·5	39·8	47·0	42·0
50	39·0	21·9	49·0	23·9	56·0	26·3	45·0	27·9	39·0	30·4	28·0	35·4
16	12·5	14·6	15·7	16·5	17·9	20·4	14·4	20·9	12·5	23·0	9·0	27·0
5	3·9	10·5	4·9	11·9	5·6	15·9	4·5	17·0	3·9	20·1	2·8	24·2

50 percentile .. .. $s = 2{\cdot}46a + 21{\cdot}4$
84 percentile .. .. $s = 2{\cdot}11a + 30{\cdot}8$
95 percentile .. .. $s = 1{\cdot}68a + 36{\cdot}6$

The scores for different percentiles for different ages are summarized below :

Percentiles	5	16	50	84	95
11 years	10·0	14·6	21·4	30·8	36·6
12 years	12·7	16·9	23·9	32·9	38·3
13 years	15·3	19·2	26·3	35·0	40·0
14 years	18·0	21·5	28·8	37·1	41·6
15 years	20·6	23·8	31·2	39·2	43·3
16 years	23·3	26·1	33·7	41·4	45·0

From the conversion table thus prepared (Table 16) the distribution of IQ's for the whole group was found to be as follows :

IQ's	Frequency
130 and above	12
125 – 129	14
120 – 124	19
115 – 119	26
110 – 114	52
105 – 109	61
100 – 104	65
95 – 99	72
90 – 94	51
85 – 89	46
80 – 84	35
75 – 79	25
70 – 74	19
Below 70	15
Total	512

The Mean was found to be 98·73, and the Standard Deviation 15·09 IQ points.

(c) *Standardization for Literates with best weights to predict* I_1

The reciprocal matrix[34] of the coefficients of correlation of the five tests of the battery, denoted throughout by the numbers 2, 3, 4, 5 and 6 (as in Chapter V), was calculated (Table 5). This was done to enable us to calculate readily regression coefficients for predicting whatever criterion might be decided upon on the basis of our analysis. The regression coefficients for predicting Binet IQ's were found to be :

Kohs'	(2)	.. .. ..	0·2643
Passalong	(3)	.. .. ..	0·0224
Patterns	(4)	.. .. ..	0·2104
Memory	(5)	.. .. ..	0·3093
Pictures	(6)	.. .. ..	0·1140

which gave $r_m^2 = 0{\cdot}3771$ and maximum multiple correlation $r_m = 0{\cdot}6141$. It was therefore evident that the battery could not be used for predicting Binet IQ's, as, indeed it had not been meant to do, and as has been found in the case of other Performance Test batteries also.[35]

For predicting the factor I_1, the regression coefficients were found to be :

Kohs'	(2)	.. .. ..	0·3691
Passalong	(3)	.. .. ..	0·2707
Patterns	(4)	.. .. ..	0·2912
Memory	(5)	.. .. ..	0·0728
Pictures	(6)	.. .. ..	0·1937

which gave $r_m^2 = 0{\cdot}7360$ and maximum multiple correlation with I_1 as $r_m = 0{\cdot}8579$.

It was therefore decided to make use of the battery for predicting I_1.

As Memory (5) contributed practically nothing towards this prediction, it was decided to leave it out. Tests 2, 3, 4 and 6 only were used.

As the regression coefficients for these tests as standing above would not be quite the same with Memory (5) omitted, and as the calculation of the reciprocal for 2, 3, 4 and 6 alone involved

TABLE 5

RECIPROCAL MATRIX OF THE CORRELATIONS FOR CONSTANT AGE FOR TESTS 2, 3, 4, 5 & 6

		Kohs'	Passalong	Patterns	Memory	Pictures
		2	3	4	5	6
Kohs'	2	1·48853	—0·28187	—0·54933	—0·09216	—0·24108
Passalong	3	—0·28187	1·36664	—0·27905	—0·17798	—0·29063
Patterns	4	—0·54933	—0·27905	1·42621	0·02350	—0·15239
Memory	5	—0·09216	—0·17798	0·02350	1·05806	—0·06069
Pictures	6	—0·24108	—0·29063	—0·15239	—0·06069	1·24899

TABLE 6

RECIPROCAL MATRIX OF THE CORRELATIONS FOR CONSTANT AGE FOR TESTS 2, 3, 4 & 6 ONLY

		Kohs'	Passalong	Patterns	Pictures
		2	3	4	6
Kohs'	2	1·48051	—0·29737	—0·54650	—0·24636
Passalong	3	—0·29737	1·33669	—0·27358	—0·30084
Patterns	4	—0·54650	—0·27358	1·42531	—0·15052
Pictures	6	—0·24636	—0·30084	—0·15052	1·24550

only one extra pivotal condensation in addition to those already performed, it was decided to obtain the fresh reciprocal matrix for 2, 3, 4 and 6 alone, in order to ensure as much accuracy in the final prediction of I_1 as possible. This reciprocal matrix for 2, 3, 4 and 6 alone is given in Table 6 and the regression coefficients as obtained with the help of this matrix are given below. It may be pointed out that the regression coefficients in every case were checked by the method of pooling squares.

Kohs'	(2)	.. .. ..	0·3755
Passalong	(3)	.. .. ..	0·2829
Patterns	(4)	.. .. ..	0·2889
Pictures	(6)	.. .. ..	0·1979

which gave $r_m^2 = 0{\cdot}7311$ and maximum multiple correlation with I_1 as $r_m = 0{\cdot}8550$. The weights to be given to the raw scores of these tests were the numbers obtained by dividing the regression coefficients by the standard deviations of the tests, as the raw scores must first be converted into standard scores (i.e. scores with the same standard deviation, usually unity, and mean equal to zero) before being multiplied by the regression coefficients. The weights were found to be :

Kohs'	(2)	.. ..	=	$\frac{0{\cdot}3755}{3{\cdot}82}$	=	0·09831
Passalong	(3)	.. ..	=	$\frac{0{\cdot}2829}{3{\cdot}36}$	=	0·08423
Patterns	(4)	.. ..	=	$\frac{0{\cdot}2889}{2{\cdot}98}$	=	0·09698
Pictures	(6)	.. ..	=	$\frac{0{\cdot}1979}{2{\cdot}72}$	=	0·07278

These weights were all multiplied by 10 (i.e. the uniform standard deviation was assumed to be 10) in order to bring them as near unity as possible. Finally, in the weighted standard scores obtained with the help of these multipliers, suitable positive constant numbers were added to obviate negative numbers in

TABLE 7

LITERATES: DISTRIBUTION OF WEIGHTED SCORES

Scores	11 years		12 years		13 years		14 years		15 years		16 years		Totals
	f	cum. *f*	*f*	cum. *f*	*f*	cum. *f*	*f*	cum. *f*	*f*	cum. *f*	*f*	cum. *f*	*f*
60 – 64 ..	..		..		..		..		2	89	1	109	3
55 – 59 ..	..		..		..		3	122	0	87	1	108	4
50 – 54 ..	..		..		1	134	3	119	6	87	8	107	18
45 – 49 ..	1	86	2	102	5	133	6	116	9	81	15	99	38
40 – 44 ..	1	85	7	100	12	128	17	110	20	72	23	84	80
35 – 39 ..	5	84	12	93	26	116	29	93	24	52	22	61	118
30 – 34 ..	12	79	20	81	40	90	21	64	15	28	12	39	120
25 – 29 ..	25	67	28	61	16	50	17	43	7	13	16	27	109
20 – 24 ..	22	42	15	33	16	34	12	26	4	6	6	11	75
15 – 19 ..	15	20	16	18	14	18	14	14	2	2	5	5	66
10 – 14 ..	5	5	2	2	4	4	..		..		..		11
Totals ..	86		102		134		122		89		109		642

Percentiles	%	Score	%	Score	%	Score	%	Score	%	Score	%	Score	
95	81·7	37·2	96·9	42·3	127·3	44·2	115·9	49·4	84·6	52·5	103·5	52·3	
84	72·2	31·7	85·7	36·5	112·6	38·8	102·5	42·3	74·8	46·1	91·6	47·0	
50	43·0	24·7	51·0	27·7	67·0	31·6	61·0	33·8	44·5	37·9	54·5	38·0	
16	13·8	17·4	16·3	19·0	21·4	20·6	19·5	21·8	14·2	29·9	17·4	26·5	
5	4·3	13·8	5·1	15·5	6·7	15·5	6·1	16·7	4·4	22·5	5·5	19·9	

the weighted scores. The weighted scores were thus worked out. From the rounded weighted scores, a conversion table (Table 17) was obtained to convert the raw scores of these tests to the weighted scores.

The weighted total scores obtained with the help of this conversion table were tabulated for each age-group in a manner similar to that described in section (*a*) above. The table is given as Table 7. Percentile graphs were drawn, and it was found that the nature of the graphs was the same as in (*a*), and they were therefore treated as in (*a*). Finally a table of norms was calculated and a conversion table (Table 18) for obtaining what may be called Performance Quotients, PQ's (as distinguished from Intelligence Quotients), was prepared.

VII. THE RELIABILITY AND VALIDITY OF THE BATTERY, AND A COMPARISON OF THE PERFORMANCE OF THE LITERATE AND ILLITERATE GROUPS

The problem of reliability and validity, particularly the latter, is a difficult one for tests of a new type, and especially for groups amongst which no tests have been employed before. The difficulty in regard to reliability is due to the particular type of tests which we are dealing with. In tests of our type the repetition of the scale on the same group after an interval of time, as has been pointed out by Alexander,[36] is the only practicable method for establishing reliability, although this method too is considered by many to be unsatisfactory; for example Kuder and Richardson say: 'The retest coefficient on the same form gives, in general, estimates that are too high, because of material remembered on the second application of the test. This memory factor cannot be eliminated by increasing the length of the time between two applications because of variable growth in the function tested within the population of individuals. These difficulties are so serious that the method is rarely used'.[37]

The difficulty of validation lies in securing a suitable criterion against which the test may be validated. As has been recently pointed out by McLeish,[38] and has often been recognized, validation often involves argument in a circle. The difficulty of securing a suitable external criterion remains over and above this. Various investigators have therefore sought to employ various devices to establish the validity of their tests. McLeish, quoted above, has sought to employ the device of factorial analysis for this purpose; and this device is well worth examining. Wechsler, author of the well-known Bellevue Intelligence Scales, justified his scales on the basis of the correlations of the scales with a number of such criteria as teachers' ratings, psychologists'

recommendations, Binet tests, etc., but did not demand a high degree of correlation with any of them. He makes two statements in this connexion. First, that:

'The Bellevue Scales were devised because of the belief that the Binet Scales were not sufficiently "good" measures of intelligence for adults. Otherwise, indeed, we should not have gone to the trouble of devising our tests.'[39]

And, second, that: 'No new test can be markedly out of line with established measures of intelligence and still claim to be "good" measures of it, because that would be tantamount to saying that all other tests were not reliable measures of it. But the degree to which any new test correlates with established tests (e.g., the Binet) cannot in and of itself be accepted as a basic proof of the new test's validity.'[39]

This would mean that a certain degree of correlation with the established measures is desirable but that a high degree of it is not essential.

It would appear that the validity of a test would ultimately be established only after its use for some time by others besides the author. The accumulated experience of the users of the test would alone establish the validity and indicate how well the test works. All that the constructor of the test can do therefore is to gather together all the evidence (within the test as well as in relation to external criteria) which has any bearing on this problem, and to show that all such evidence leads one to expect that the test will fulfil its function as well as tests of this kind may usually be expected to do. We shall here collect together all such evidence in regard to the reliability and validity of our battery of tests.

Reliability of the Battery

We are not able to present here data about the retest reliability of our battery, even if that were acceptable, for we were not able to secure a sufficient number of retest cases recorded at suitable intervals of time, i.e. not immediately after (i.e. a

day or two after) the original, because of various practical difficulties. We however present data on the basis of the split-half method of testing reliability with the full realization that this too has limitations in the case of our battery.

To obtain two equivalent parts of the test, we have equated the scores on the odd and even sub-tests within each test of the battery. Our tests being graded in point of difficulty, the odd items are necessarily easier than the even ones. To balance this, we combined the scores on the *odd* sub-tests of the first three tests (i.e. Kohs', Passalong and Patterns) with the *even* sub-tests of the last two (i.e. Memory and Pictures; Memory having two parts—Direct and Reverse). In the case of both the literate and the illiterate groups, a number of random scripts were selected for this purpose—every fifth subject being taken for this purpose. The scattergram for the literate group is as follows:

	5 –	10 –	15 –	20 –	25 –	30 –	35 –	40 –	*f*
40 –									
35 –						2		1	3
30 –					4	7			11
25 –				5	23	7			35
20 –			7	25	6	3			41
15 –		4	16	11					31
10 –	3	7	3						13
5 –	1								1
f	4	11	26	41	33	19	0	1 :	135

This gives a Pearson correlation coefficient, $r = +0{\cdot}851$.

For the illiterate group, this scattergram is as follows:

	3 –	6 –	9 –	12 –	15 –	18 –	21 –	24 –	*f*
27 –								1	1
24 –							2		2
21 –				1	3	0	1		5
18 –				1	3	7	2		13
15 –				8	8	1			17
12 –			8	17	6				31
9 –	2	5	14	6					27
6 –		4	1						5
3 –	2								2
	f 4	9	23	33	20	8	5	1	: 103

This gives a Pearson correlation coefficient $r = + 0{\cdot}841$. These values would appear to be as satisfactory as one could expect from tests of this type.

In regard to reliability, it may be further pointed out that two of the tests in our battery—Kohs' and Passalong—are standard tests whose reliabilities are usually accepted to be satisfactory. Our Memory test, even with its adaptation for illiterates, is not essentially different from the usual Memory test. The addition of two new tests—the Patterns and the Pictures—has therefore, it would appear, done nothing to detract from the reliability of the battery as a whole, if indeed they have not further strengthened it. For, in the factor analysis, as reported in Chapter V, these two tests go quite well with

Kohs' and Passalong tests, the Pattern test being perhaps more akin to Kohs' than even Passalong is to Kohs', with which it is usually used in combination in batteries.

Validity of the Battery

For Literates. The test was validated against teachers' opinions obtained on a five-point scale of Very Superior, Superior, Average, Inferior and Very Inferior, the corresponding IQ intervals being Above 130, 110 – 129, 90 – 109, 70 – 89, and Below 70. The information was available for 423 cases and is given below :

	V. Inf.	Inf.	Av.	Sup.	V. Sup.	Totals
Above 130 ..				4	3	7
110 – 129 ..			27	64	4	95
90 – 109 ..		3	167	24		194
70 – 89 ..		38	72	2		112
Below 70 ..	2	9	4			15
Totals ..	2	50	270	94	7	423

This gives a Pearson coefficient of correlation, $r = +0{\cdot}703$.

For Illiterates. The test was validated against the general opinion held in the village about the intelligence of the boy. This was obtained on a five-point scale of Very Superior (i.e. Very Bright), Superior (i.e. Bright), Average (i.e. Ordinary), Inferior (i.e. Dull) and Very Inferior (i.e. Very Dull); and it was not difficult to obtain such evaluation on the part of the village folk. The data was available for 302 cases and is given below :

	V. Inf.	Inf.	Av.	Sup.	V. Sup.	Totals
Above 130 ..				8	1	9
110 – 129 ..		1	35	16		52
90 – 109 ..		20	114	4		138
70 – 89 ..	8	54	28			90
Below 70 ..	8	4	1			13
Totals ..	16	79	178	28	1	302

This gives a Pearson coefficient of correlation, $r = +0{\cdot}717$.

It has already been pointed out that the IQ's here are those obtained on the basis of the performance of the illiterate group alone.

From these figures it will be seen that the validation figures are almost as good as could be reasonably expected under the circumstances.

It may be mentioned here that in the literate group it was found that the scale of the teacher's estimate had consistently lowered itself in the case of those schools and areas where the average intelligence was low, so that boys whose IQ's were in the interval 70 – 89 were uniformly assessed by these teachers as 'Average', and so on. As in the table presented above we have pooled together all results irrespective of these considerations, this has obviously brought down the correlation between our IQ's and teachers' estimates. We do not present the additional data about the variability of the teachers' standards here as it is not relevant to our present problem.

In the case of the illiterate group, no better correlation could naturally be expected in view of the lack of reliability of the ratings themselves.

Further, the circumstantial evidence discussed below is, we consider, very sustaining and useful for the reliability and validity of our battery. This was obtained by a comparison of our battery with Binet tests, and by an examination of the factorial content, (particularly the loadings for factor I_1) of our constituent tests.

In regard to the Binet tests, we notice that our battery correlates to the extent of the maximum multiple correlation (with best weights, age partialled out), $r_m = 0{\cdot}614$, but not completely. This is the correlation one would expect to exist between them in view of the fact that the two give assessments of a common mental ability, in particular g, but do not have the other factors, such as v, k etc., common. This correlation would result on the basis of the commonly accepted loadings of g in the Binet and the Performance tests of the type used

in our battery. Indeed this is the order of correlation which has also been found in other investigations of Binet and Performance tests.[40]

An examination of the loadings of the different tests of our battery on the factor I_1 gives further evidence in regard to the reliability of the battery. Kohs' and Passalong are tests which have already been used much elsewhere. Their *g*-loadings are fairly well known and are commonly accepted as valid. Their loadings as obtained by us in our battery are of the same order. The reliability and validity of these two parts of our battery would therefore appear to be sound. The other two tests of the battery—Patterns and Pictures—which are new, have loadings on the factor I_1 practically similar to those of Kohs' and Passalong, and should therefore also have a reliability and validity not much lower than the latter. The Memory test is, however, differently placed in this respect, but it goes well with the Binet tests of which it is really a part. It is, however, not an altogether new test as used in our battery, even in its adapted form for illiterates.

The reliability and validity of our battery as a whole would therefore appear to be reasonably sound.

Comparison of the Illiterate and Literate Groups

This brings us to a topic of great fundamental importance in psychology and one on which great and often violent differences of opinion occur—namely, the relation of native intelligence to environmental differences, particularly the cultural and racial. It is not our purpose here to enter into any detailed discussion of the topic, because that would demand a separate study; but as we are able to present an amount of objective data in this connexion which has not very often been available so far,[41] we shall summarize our data here and recapitulate the background. We shall also give our own interpretation of the results, keeping in view what is generally acceptable in psychological circles at the present time.

In the first place we have to point out that the differentiation of our literate and illiterate groups is not so much in terms of racial and cultural environment as in terms of the general and educational environment. There might possibly be some racial differences between those who are known as 'backward' classes and those who are classified as the 'higher' classes (although these have not generally been accepted as valid), but there is essentially *no* cultural difference either between the 'backward' and the 'higher' communities, or between the literate and the illiterate groups. Culturally, the 'backward' and the 'higher', as well as the literate and the illiterate, form a single whole. Not only do the 'backward' and the 'higher' classes, and the literates and the illiterates, share the same geographical areas and form part of the same sections of population, but the 'backward' and 'higher' communities are almost equally literate or illiterate. Illiteracy, wherever it exists, is quite general and cuts across the social strata evenly. The distinction between our literate and illiterate groups, it would thus appear, lies more in an opportunity to come in contact with a certain educational and general environment than in any other circumstance.

The illiterates have the same general Indian culture as the literates. They have however the disadvantage that they have been denied certain additional opportunities available to the latter. If a distinction in terms of culture were to be attempted, it would be as if the illiterates were left alone to retrogress in certain respects while the literates have not done so. Although the illiterates have been denied certain opportunities, they inherit a way of life equally shared by the literates. They are not, in comparison to the literates, primitive in any sense of the word. For example, they realize the value of education and of good living generally, but have reached a state of acquiescence in their existing condition, perhaps simply on account of historical reasons.

To the above statement on the distinction of our two groups, we add the following points in regard to our present investigation, which indicate the special advantages available to us:

1. We were able to secure direct contact with our subjects and establish perfect rapport with them, there being no cultural, linguistic or social differences between ourselves and our subjects, all being citizens of the same land—an advantage very often denied to other investigators.
2. We were able to test a substantial sample of the population, both literate and illiterate, the sample being representative from the point of view of geographical distribution, occupations, and communities, as the standardization data given in Chapter IV indicate.
3. The same testers have tested both the illiterate and the literate groups, often in contiguous or the same areas. Any personal equation that may be involved is therefore eliminated.

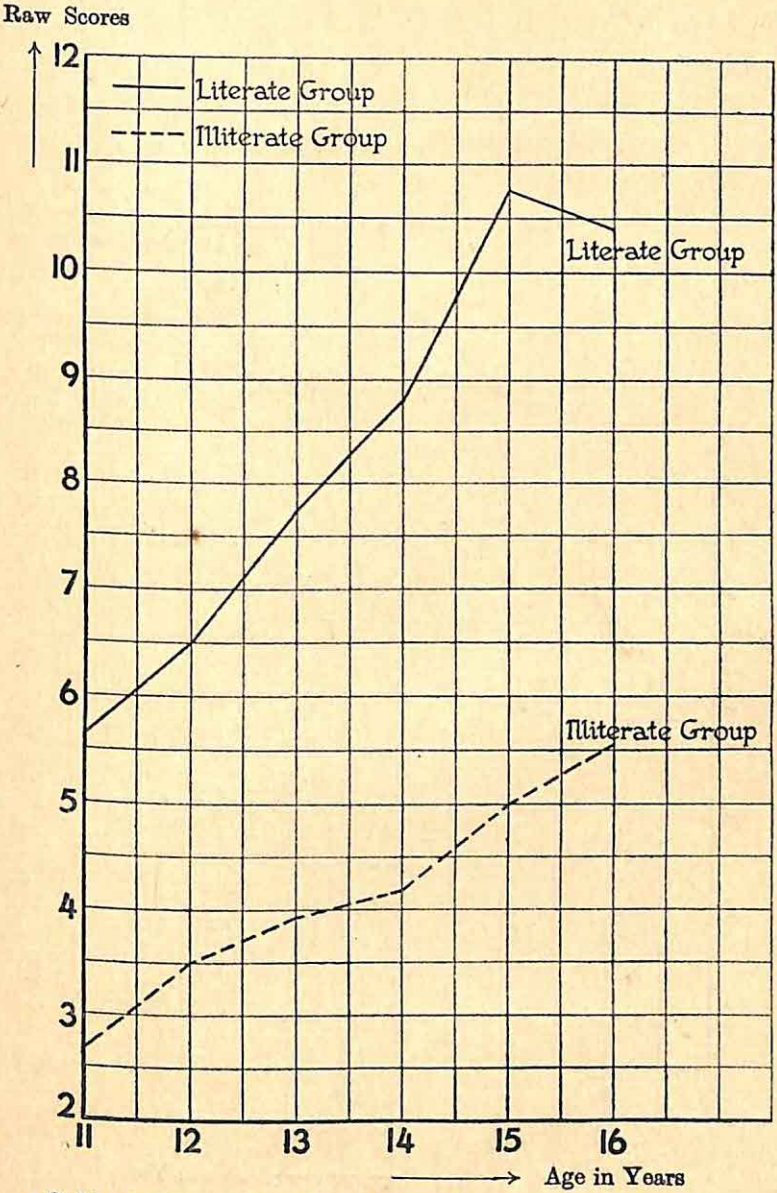
The necessary statistics for the raw scores of the different tests are given below (see also the graphs in each case), n being equal to 642 for literates and to 512 for illiterates in each case:

KOHS' TEST

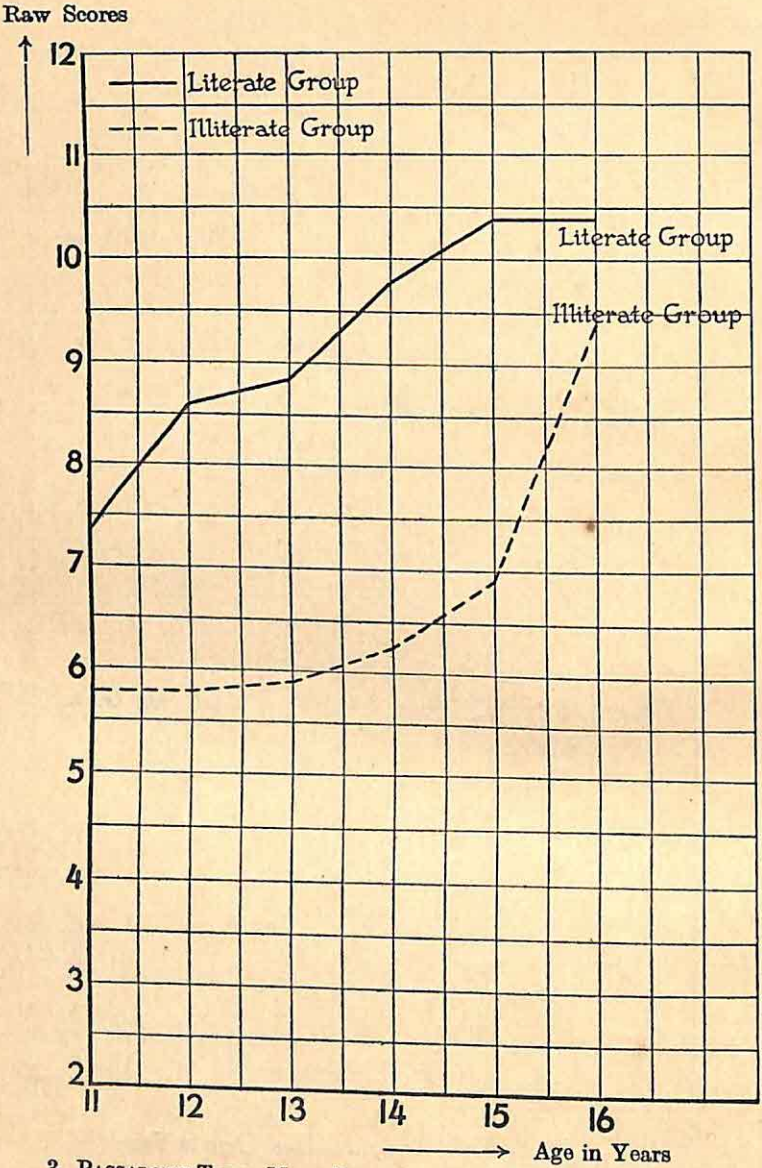
	Literates	Illiterates
Mean (M)	8·33	4·09
σ_M (Standard error of M) ..	0·15	0·10
S.D. (σ)	3·82	2·22
σ_σ (Standard error of σ) ..	0·11	0·07

PASSALONG TEST

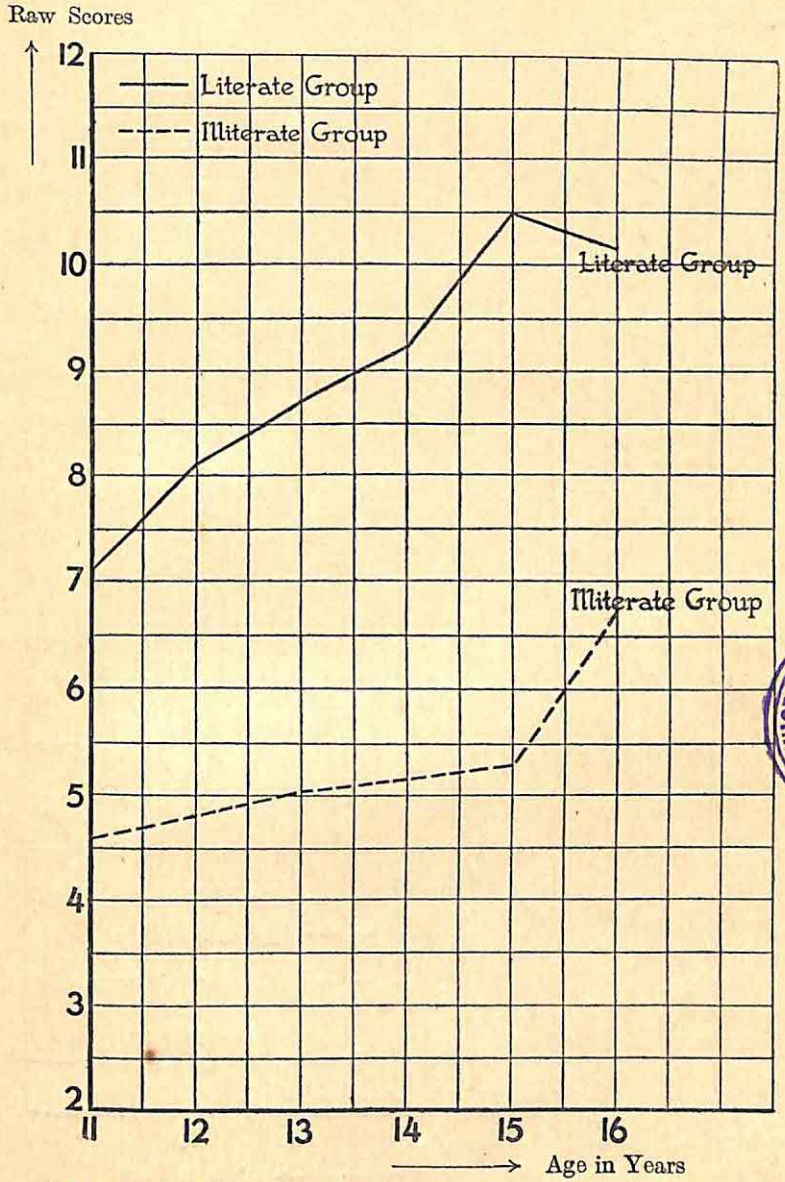
	Literates	Illiterates
Mean (M)	9·27	6·43
σ_M (Standard error of M) ..	0·13	0·13
S.D. (σ)	3·36	2·89
σ_σ (Standard error of σ) ..	0·09	0·09



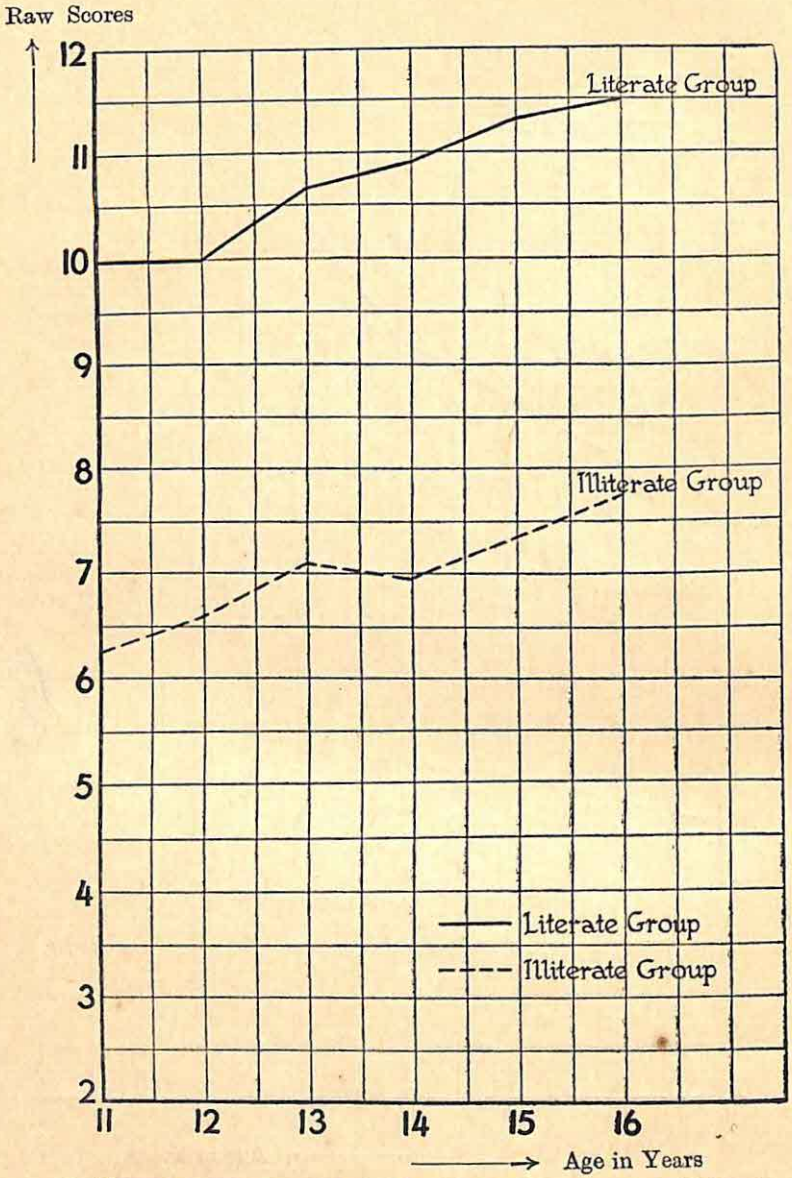
2. KOHS' TEST: Mean Raw Scores for Literate and Illiterate Groups



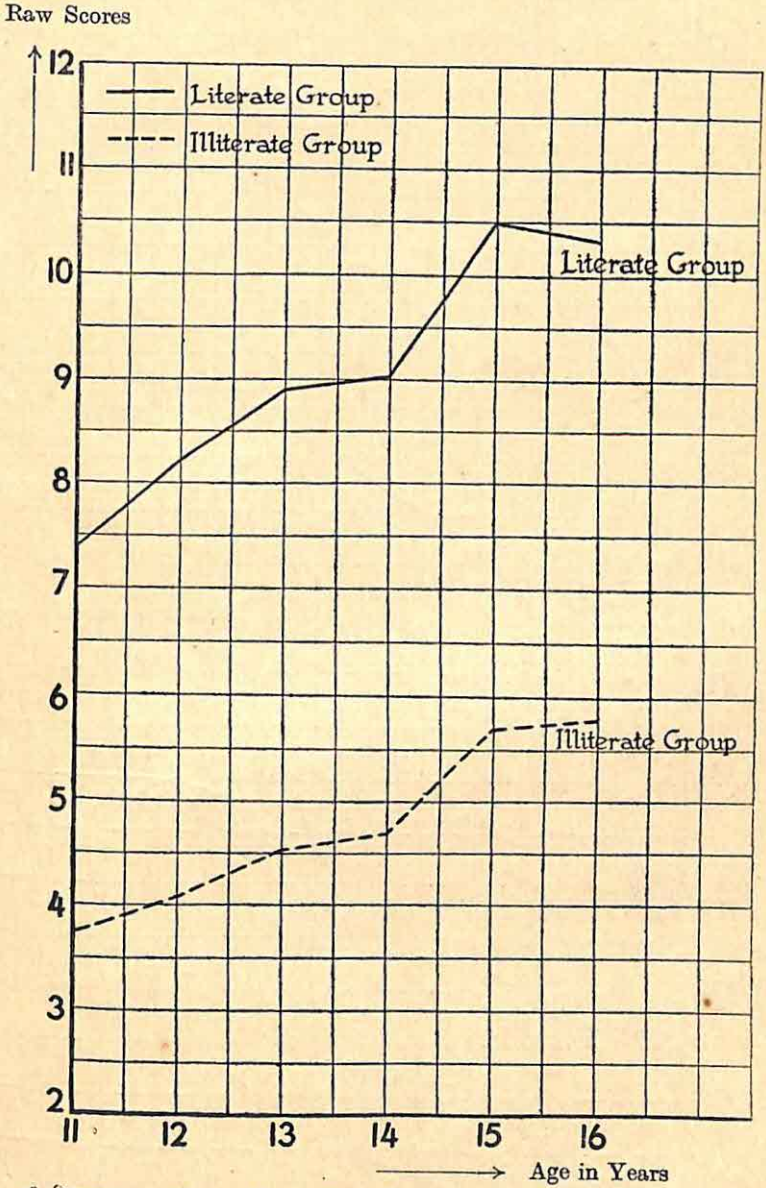
3. PASSALONG TEST: Mean Raw Scores for Literate and Illiterate Groups



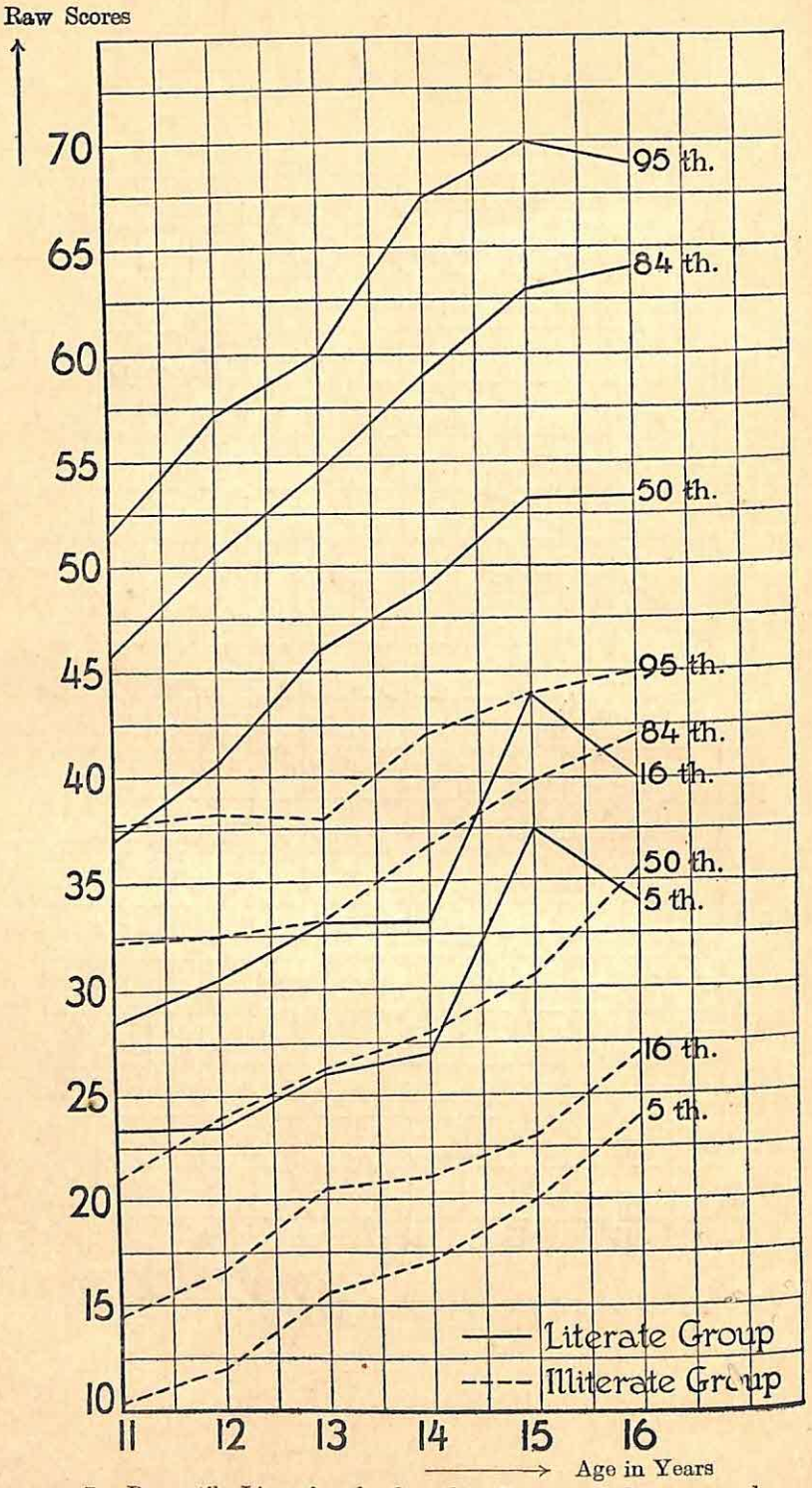
Patterns Test: Mean Raw Scores for Literate and Illiterate Groups



5. MEMORY TEST: Mean Raw Scores for Literate and Illiterate Groups



6. PICTURES TEST: Mean Raw Score for Literate and Illiterate Groups



7. Percentile Lines for the Complete Battery for Literate and Illiterate Groups

PATTERNS TEST

	Literates	Illiterates
Mean (M)	9·00	5·18
σ_M (Standard error of M) . .	0·12	0·10
S.D. (σ)	2·98	2·18
σ_σ (Standard error of σ) . .	0·08	0·07

MEMORY TEST

	Literates	Illiterates
Mean (M)	10·77	6·95
σ_M (Standard error of M) . .	0·07	0·09
S.D. (σ)	1·84	2·04
σ_σ (Standard error of σ) . .	0·05	0·06

PICTURES TEST

	Literates	Illiterates
Mean (M)	9·08	4·67
σ_M (Standard error of M) . .	0·11	0·09
S.D. (σ)	2·72	2·02
σ_σ (Standard error of σ) . .	0·08	0·06

The percentile lines for raw scores for the *complete* battery for the literate and the illiterate groups have also been drawn on the same graph (see Graph 7) to show the relative overlap of the two groups.

From the above, the following inferences may be drawn:

1. The means for the two groups, in all five tests, are significantly different, being consistently higher in the case of the literate group. The nearest approach of the two means to each other is in the case of the Passalong test, although the difference in that case also is statistically significant.

2. The difference in the standard deviations is not so marked; in the Kohs', Passalong, Patterns and Pictures Tests, it is greater for literates than for illiterates (being probably significant), and in the Memory test, it is greater for illiterates than for literates (being not significant). On the whole, there is no definite evidence that the standard deviations are different in the two groups.

3. The growth curves for all the five tests, as well as for the composite battery, for both the groups seem to follow the same general pattern, but in the case of illiterates, the curves do not suggest any ceiling tendency about 15 to 16 years.

The performances of the two groups therefore do not suggest any essential differences except in the following respects:

1. The level of performance is lower in the case of illiterates.
2. The Passalong test appears to bridge the gulf between the two groups better than any other test from amongst those used by us.
3. The mental growth of illiterate adolescents needs further investigation.

Our findings are in part similar to those of Nissen, Machover and Kinder,[42] who state: 'The inferiority of our subjects in test scores as compared with the standardization groups is unequivocal, but the applicability of the conventional sociological interpretation of this inferiority is open to question.' Further, they found that the performance of their group on the Cube Imitation and the Adaptation Board tests was comparatively better than on the Ship, Manikin, Feature Profile and Digit Symbol tests.

The only other direct evidence bearing on cognitive differences as between races and cultures is that of Thouless,[43] who investigated the index of phenomenal regression to the real object in perception in the case of Indian students as compared with British students. The subjects were 20 Indian students, as against a control group of 49 British students, and

Thouless concluded that 'the group of Indian students show a significantly greater tendency to phenomenal regression to the real object than a control group of British subjects'.

Other evidence on the problem is only of a general nature and has been obtained by the application of current intelligence tests. This, besides being often contradicted or at least criticized and regarded as unacceptable, does not throw light on the fundamental cognitive processes of Perception, Abstraction or Reasoning, etc., as such.

In regard to the two foremost investigators on the intelligence of racial groups most often quoted, namely Brigham and Goodenough, it may be stated that they do not any longer hold that the common intelligence test is efficacious in deciding the question of comparative intelligence when the groups are far apart in racial, cultural or environmental conditions. Brigham[44] says that 'the comparative studies of various national and racial groups may not be made with existing tests', and Goodenough[44] and Harris state recently (1950) that they 'would like to express the opinion that the search for a culture-free test, whether of intelligence, artistic ability, personal-social characteristics, or any other measurable trait is illusory, and that the naive assumption that the mere freedom from verbal requirements renders a test equally suitable for all groups is no longer tenable'. Further Margaret Mead in her chapter on 'Research on Primitive Children'[45] concludes: 'To date, no data have been advanced which actually call into question the basic ethnological assumption of the non-existence of innate psychological differences between races.'

It would therefore appear to us that in the matter of racial differences the UNESCO *Statement of Race* is the best hypothesis to work upon at the present moment, namely that:

'It is now generally recognized that intelligence tests do not in themselves enable us to differentiate safely between what is due to innate capacity and what is the result of environmental influences, training and education. Wherever it has been possible

to make allowances for differences in environmental opportunities, the tests have shown essential similarity in mental characters in all human groups.'[46]

We believe therefore that the lower performance of the illiterate group on our battery does not necessarily indicate a lower innate mental ability on the part of that group. Indeed, while in the act of administering these (or in fact any similar) tests to these boys, one could not fail to notice the marked strangeness and unfamiliarity of the whole situation for them. For example, in the case of the Memory test (even in its modified form), one noticed that the boys were simply *not accustomed* to this sort of *paying attention* to a certain situation. The concentration of attention which any test situation requires appears quite foreign to them. It appears to the present writer that this paying of attention to essentially abstract situations for any considerable length of time is essentially the result of formal school practice and the demands of civilization. The boy reared away from civilization feels 'freer' in the atmosphere of an outdoor life of movement and activity—where he seems to utilize himself fully—rather than in the world of mental concentration and of abstract thought. It suggests to the present writer that the comparatively better performance of the illiterate group on the Passalong test than on any of our remaining tests may perhaps be explained by the fact that of all the Performance tests we employed, this was the only one which provided an opportunity to actually *move* objects about, in which act illiterate boys felt at home and took natural and great delight.

When this much has been said for the environmental influences, it must be pointed out that this does not either deny or minimize innate hereditary factors. The above only indicates the uncertainty of comparative judgement in regard to differing groups; it does not deny the certainty of judgement about the comparative intelligence of individuals *within* a particular group. Within a group, whether consisting of illiterates or literates, the

test does differentiate, and differentiate successfully, between the different levels of intellectual ability, for we find that in the case of the illiterate group too the dispersion comes out practically the same as in the case of the literate group, indicating that individuals within the respective groups are being equally differentiated. It is in this differentiation that the utility of intelligence tests, as also of our battery of tests, actually lies.

VIII. SOME RESULTS OF SOCIOLOGICAL AND EDUCATIONAL INTEREST

Sociological Results

Literates: (*a*) *Occupations*

We give in Table 8 the IQ's of the subjects from the point of view of the occupation of their parents. It will be seen that Higher Professions come at the top, Agriculture and Labour at the bottom, and Middle Class Service and Business in between. The differences between the Mean IQ's of these different groups, and their significance, are presented in the table opposite (for the Mean IQ's, S.D.s and σ_M and the number, n of the different groups, see Table 8):

Table 8

IQ's ACCORDING TO OCCUPATIONS (LITERATE GROUP)

Occupation	Number	Percentage of the whole	Mean IQ (M)	S.D. (σ)	σ_M
Higher Professions (Income above Rs 200 p.m.)	135	21·03	106·52	13·81	1·19
Middle Class Service (Income Rs 100 to Rs 200 p.m.)	227	35·36	100·37	13·44	0·89
Lower Class Service (Income below Rs 100 p.m.)	47	7·32	93·49	13·68	1·69
Business ..	83	12·93	96·88	13·17	1·44
Agriculture .. (including landlords)	92	14·33	91·29	16·41	1·71
Not Recorded .. (including orphans and unemployed)	58	9·03	..	..	..
Totals ..	642	100	99·37	14·62	0·58

Note: Higher Professions include Lawyers, Doctors, Engineers, Teachers and high Government officials.

Middle Class Service includes Clerks, Railway employees, Mechanics and others serving in public offices.

Lower Class Service includes Labourers.

LITERATES—OCCUPATIONS

	D (difference in Mean IQ in favour of the former)	σ_D	$\frac{D}{\sigma_D}$	Significant or not
Professions – Middle Class	6·15	1·48	4·15	Yes
Professions – Lower Class	13·03	2·31	5·62	Yes
Professions – Business	9·64	1·86	5·16	Yes
Professions – Agriculture	15·23	2·08	7·31	Yes
Middle Class– Lower Class	6·88	2·17	3·15	Yes
Middle Class– Business	3·49	1·69	2·06	Probable
Middle Class– Agriculture	9·08	1·92	4·71	Yes
Business – Lower Class	3·39	2·45	1·38	No
Business – Agriculture	5·59	2·23	2·50	Probable
Lower Class – Agriculture	2·20	2·62	0·83	No

The above indicates that children of parents from higher Professions are definitely superior to others, and that those of the Middle class are superior to the Lower and Agriculture classes, and probably to the Business class also, while those of the Business class, Lower class and Agriculture class do not differentiate among themselves. This sociological order would appear to be similar to that found in investigations in Western countries, and generally corroborates the results of Sohan Lall's[47] survey of school-going pupils carried out some years earlier. Two points may however be mentioned in this connexion. First, that this occupational classification and result are applicable to the Literate population only; second, it has to be remembered that the Business class in ordinary Indian cities often means ordinary shopkeepers, and rarely signifies the Big Business which it often means in industrialized Western countries.

TABLE 9

GEOGRAPHICAL DISTRIBUTION OF IQ's (LITERATE GROUP)

Places	Number	Percentage of the whole group	Mean IQ
Allahabad 1 (Urban) ..	100	15·58	105·15
Allahabad 2 (Urban) ..	86	13·40	100·14
Gorakhpur (Urban).. ..	35	5·45	103·71
Karanprayag (Garhwal) Urban ..	46	7·17	94·93
Jhansi (Urban)	66	10·28	94·80
Sultanpur (Rural)	64	9·97	80·75
Allahabad 3 (Urban) ..	125	19·47	102·08
Bareilly (Urban)	120	18·69	104·04
Totals	642	100	99·37

Literates: (*b*) *Geographical*

We present in Table 9 the numbers and the mean IQ's of groups drawn from different places. Besides the small variations from place to place and from school to school, there does not appear to be any marked and fundamental difference among these groups, with *one* exception. This is the group drawn from the single rural area from which we drew a sample. This rural group (Sultanpur—rural) seems to stand out distinct from the rest. The difference (D) in the mean IQ of the total group and this group is 18·62 IQ points, $\sigma_D = 1{\cdot}64$ points, and $D/\sigma_D = 11{\cdot}32$. The difference is thus significant, and would point to the conclusion that, even among literate children, those from rural areas do not fare as well as those from urban areas. Our rural sample is drawn from *one* area only, but if it can be taken to be at all representative of the rural areas in general, it would leave no doubt on the point. Of course, rural children have been found in many other investigations in other countries also not to fare as well in intelligence tests as urban children, but the

importance of the above result in our case is that it indicates that the intelligence of the *illiterate rural* child is complicated by two factors and not merely one, namely that of illiteracy.

Literates: (*c*) *Communities*

Table 10 gives the relevant information from the point of view of communities and is in general in line with the findings of the only other survey made in this area, viz. that of Sohan Lall, already referred to above. In the present survey too, Muslims are not found to differ from the Hindus, and the Kayastha community scores highest among the different Hindu communities. What is perhaps most significant is that the Backward communities do not show any inferiority in comparison to others. It should be remembered that these children of 'backward' communities are those who have received ordinary education. Our results, therefore, would seem to indicate the probability of a general equality among different communities when equal

TABLE 10

COMMUNITYWISE DISTRIBUTION (LITERATE GROUP)

Community	Number	Percentage of the whole group	Mean IQ
Brahmins	139	21·65	97·86
Kshattriyas .. .. .. (including Khattris)	62	9·66	95·39
Kayasthas	122	19·00	101·18
Vaishyas	42	6·54	98·18
Christians and Anglo-Indians	65	10·12	104·30
Muslims	120	18·69	99·33
Backward Communities ..	31	4·83	98·61
Others including Parsis, Sikhs, etc. and those not recorded	61	9·50	..
Totals	642	100	99·37

opportunities for education have been provided to them. The rather high mean IQ of the Anglo-Indian and Christian group is due to the fact that this is a select group, the parents of these children being very high in the occupational level.

In Table 11, we have given the Mean IQ's and S.D.s, gradewise, of pupils from two regions (Government Intermediate College, Allahabad and Bareilly, urban) which are generally above the average in intelligence. The mean IQ's of the three different grades VII, VIII and IX are practically the same, and the S.D.s also do not differ from each other, being consistently less than in the population as a whole.

TABLE 11
GRADEWISE DISTRIBUTION (LITERATE GROUP)

School Grade	Number	Mean IQ	S.D.
VII	78	103·54	11·67
VIII	81	103·24	11·59
IX	86	103·06	11·96

Illiterates: (*a*) *Occupational*

In Table 12 we give the numbers, the Mean IQ's, S.D.s, and σ_M, of occupational groups among illiterates.

TABLE 12
IQ's ACCORDING TO OCCUPATIONS (ILLITERATE GROUP)

Occupation	Number	Mean IQ (M)	S.D. (σ)	σ_M
Farmers .. .. .. (including all workers on land)	320	97·48	15·10	0·84
Shopkeepers (Petty) ..	40	99·88	14·80	..
Artisans and Craftsmen ..	58	100·79	15·30	2·01
Labourers (Hired)	29	94·59	17·25	3·20
Domestic Servants	43	103·74	12·40	1·89
Not Recorded .. .. (including unemployed)	22	..	..	..
Totals	512	98·73	15·09	..

NOTE: Artisans and Craftsmen include Carpenters, Weavers, Barbers, Washermen, Cooks, etc.

Artisans come at the top, Shopkeepers next, Farmers follow and Labourers are last. The Domestic Servants, whose mean IQ is larger than any of the above, have really to be considered from another point of view, as they are generally drawn from the urban sample of the illiterate population whereas the rest are from rural areas.

It is however to be noticed that the difference between the mean IQ's of all the above groups, including the Domestic Servants, is *not* marked, and generally *not* significant. The table for significance is presented below :

Occupation	D (Difference in Mean IQ in favour of the former)	σ_D	$\frac{D}{\sigma_D}$	Significant or not
Artisans–Farmers	3·31	2·17	1·51	No
Artisans–Labourers.. ..	6·20	3·77	1·64	No
Domestic Servants–Farmers	6·26	2·06	3·02	Yes
Domestic Servants–Artisans	2·95	2·75	1·06	No
Domestic Servants–Labourers	9·15	3·71	2·46	Probable

The only significant difference is between Domestic Servants and Farmers ; and it would therefore appear that, unlike the literate group, the children of the illiterate group are not much differentiated among themselves from the point of view of the occupations of their parents. All the occupations of the illiterate group are practically of the same economic level, farming being the major occupation.

Illiterates : (*b*) *Geographical*

The relevant information is given in Table 13. We have found it interesting to combine the groups in four regions namely, Western, Northern, Central and Eastern. While the mean IQ's

TABLE 13
GEOGRAPHICAL DISTRIBUTION OF IQ's (ILLITERATE GROUP)

Region	Number	Mean IQ (M)	S.D. (σ)	σ_M
Western	67	100·73	15·94	..
Northern	129	103·67	14·99	1·32
Central	140	101·79	12·04	1·02
Eastern	176	91·92	14·58	1·10
Totals	512	98·73	15·09	..

of the Western, Northern and Central regions do not differ much from each other, that of the Eastern region does. The figures for the significance of their differences are given below :

Regions	D (Difference in Mean IQ in favour of the former)	σ_D	$\frac{D}{\sigma_D}$	Significant or not
Northern–Eastern	11·75	1·71	6·84	Yes
Central–Eastern	9·87	1·49	6·61	Yes

This points to the conclusion that the mean IQ of illiterate children from the Eastern region is lower than that of the illiterate children of the other regions, but that the mean IQ's of children from the latter regions do not differ among themselves. It is worth noticing in this connexion that the rural areas of the Eastern regions are generally known to be economically much poorer and generally more backward than the other regions of the state, particularly the Western and Northern, where farming is prosperous and some industrialization has also taken place. Also the rural Eastern areas are the most densely populated of all the regions.

Illiterates : (*c*) *Communities*

The relevant information is given in Table 14. It will be noticed that the higher communities, such as Brahmins,

Kshattriyas, Vaishyas and Muslims (forming a total of 155), are almost as numerous in the illiterate group as the 'backward' communities (forming a total of 269), for as we have already pointed out, wherever it is present, illiteracy is quite generally distributed.

TABLE 14
COMMUNITYWISE DISTRIBUTION (ILLITERATE GROUP)

Community	Number	Mean IQ (M)	S.D. (σ)	σ_M
Brahmins	62	106·52	..	..
Kshattriyas	41	105·32	..	..
Vaishyas	23	103·30	..	..
Muslims	29	94·93	..	..
'Backward' Communities including Ahir, Nai, Dhobi, Barhai, Kumhar, Kahar, Kurmi, Chamar, Pasi and Bhangi	269	100·38	14·35	0·87
'Non-Backward' Communities including Brahmins, Kshattriyas, Vaishyas and Muslims (as given above) combined	155	103·58	13·73	1·10
Totals	424	101·55	14·22	..

An important feature to be noticed in our investigation is that although Brahmins, Kshattriyas and Vaishyas (but not the Muslims) do show some superiority over the 'backward' communities in their intelligence scores, it is by no means a clear superiority. The figures for significance as between the 'non-backward' and 'backward' communities are $D = 3·20$, $\sigma_D = 1·40$ and $D/\sigma_D = 2·28$. In any case the overlap between the two groups (the S.D.s being 13·73 and 14·35 IQ points respectively) is so great that there are practically as many chances of discovering bright intelligent boys among 'backward' illiterate communities as among 'higher' illiterate communities, a fact which the writer found to be actually the case in investigating the intelligence of

individual illiterate boys in a particular village.[48] This points to the desirability of providing educational facilities uniformly for all.

Binet IQ's and I_1 Factor

As already discussed in Chapter VI, we have done a standardization of the battery to give the best estimate of the factor I_1, which we believe contains all that is common to Binet tests and the Performance tests, is free from verbal bias but has probably a spatial factor amalgamated with it. We present here the Binet IQ's, and the I_1 quotients, i.e. PQ's (we have called them PQ's or Performance Quotients to distinguish them from Binet IQ's) of a number of subjects to whom both the tests were administered to indicate how the PQ throws additional light on the intelligence of a subject.

Serial Number of the boy on our lists	Age in years	Binet IQ	PQ
3	11	108	105
39	11	119	101
40	11	106	117
50	11	141	130
9	12	89	94
11	13	87	81
15	13	110	115
38	13	96	95
46	13	94	77
57	13	134	97
34	14	98	114
65	14	89	116
68	14	98	130
80	15	59	77
83	16	77	106

These represent various types of subjects one may meet with. First of all there are those whose performance is similar in both the tests. Nos. 3, 9, and 38 are rather average in both; No. 50 is very good in both; No. 80 is very bad in both; No. 15 is somewhat above average in both; and No. 11 is rather below average in both. Then there are those who show some advantage in one over the other, but the difference is not marked. Such cases are Nos. 39, 40, 46, 34 and 65. Lastly, there are those who show a marked advantage in one test over the other. These are Nos. 57, 68 and 83.

The second and, particularly, the third category include cases which have a marked 'verbal' or a 'practical' bias, and to whom additional specific information about the type of their ability may be usefully provided in educational guidance and vocational guidance case-work.

Clinical Information

Our battery being administered individually, it is possible, as we hinted in the first chapter, to utilize it to obtain what may be called, for the lack of a better term, clinical information about the subject. This means individual information about the subject, not necessarily of an abnormal nature, which may not be readily classifiable in general categories.

By clinical information we do not mean to confine ourselves to the character and temperamental qualities of the subject. Performance tests are very often being recommended for obtaining temperamental and character reactions of the subjects. While Performance tests do throw some light on the temperamental qualities of the subject, our experience indicates that this is rather of a limited nature, and is such as would be forthcoming in an *individual* test situation anyway. It is not, we feel, something quite unique to Performance tests as such. We found for example that the observations of the emotional reactions of the subjects in our Record forms could at best provide answers to

the questions of the following limited categories, namely: 'Does the subject apply himself to the task steadily?' 'Does he go through it doggedly or does he give up the effort easily?' and, 'Is he excitable and easily jubilant over success or easily unnerved at failure?'.

While, therefore, we would have such observations recorded in the case of our Performance tests, we do not think that any undue importance need be attached to them. What is revealed of importance by the Performance tests of an individual nature, however, to a careful and observant tester, is, we think, the subject's mode of thinking, his particular way of meeting a cognitive situation, or, what we may say, the *quality* of his thinking, many of the features of which being of a nebulous character are not easily classifiable, or at least have not been classified so far. This information throws additional and very interesting light on the cognitive make-up of the individual; it very often explains the quantitative results of testing, and not seldom helps to resolve many of its unexplained discrepancies.

For example, in the case of Kohs' Block Design Test, it was easy to observe that a particular type of individual arrives at the solution of these problems as if he had been first able to resolve a particular given pattern into smaller patterns which he then made up with the cubes, while another type would seem to view the pattern as a whole in his mind and then would just complete it as if he were *copying* it. The former would perhaps be the individual who feels at home with 'analysis' as such, while the latter would excel at 'synthesis', although both may be generally of the same intellectual level. Individuals of the former type are comparatively more successful at Designs of the type No. 6 (ours and Collins and Drever's: Kohs' original No. 10), which have comparatively more broken lines; and individuals of the latter type are more successful at Designs of the type No. 7 (ours and Collins and Drever's: Kohs' original No. 17) which have comparatively large contiguous coloured areas. Further, in the case of some subjects, the difficulty obviously is that they

are not able to *comprehend* the design as such while in the case of the others, it would appear that although they understand what is to be achieved, they are not able to manipulate, or rather orientate, the faces of the cubes in the three-dimensional space in such a way as to achieve the desired results. This difference is particularly noticeable in the case of those subjects whose mental abilities are generally limited and who are not able to proceed much farther than the first few designs built up with the help of 4 cubes. It may be that one type—both being again of the same general mental level—is particularly deficient in the capacity for perception, while the latter is deficient in some sort of what is now regarded as spatial ability. Many of the above are important problems in cognition which are being gradually taken up by analytic methods, in particular the factorial, by experimentalists following the lead of Thurstone and others.

Similarly, our Pattern Drawing tests also reveal some interesting individual cognitive characteristics. We found that some subjects seemed to be troubled more by the mere perceptual complexity of the pattern than by the inherent difficulty of the solution. That is to say, even if the analytic solution in a particular pattern was not very much more difficult than that of the previous pattern, yet if this particular pattern contained a much larger number of lines than the previous one, such subjects would get confused on being confronted with it. There was however another type to whom a large number of lines in the pattern did not seem to give any trouble at all. If there was no great analytic difficulty involved, they seemed to draw out the design with great ease, as if they were having the picture of a continuous trace before them. It would appear that such persons are strong in visual imagery and make great use of it in solving the problems involved in the patterns of these sub-tests. Another interesting, but perhaps minor, point of observation was that the great majority found it much easier to arrive at the solution of a sub-test if the correct starting-point was at the top left hand corner than at any of the other three corners, although there were a few

to whom this was not so advantageous. This may be due to our writing habits being from left to right and top to bottom (Hindi, the mother-tongue of the great majority being also written, like English, from left to right and from top to bottom) ; or this may be connected with some other right-handed and left-handed activities of the subjects, not at present clear to us.

The detection of individual cognitive characteristics of the above nature appears to us to be of definite importance and interest when testing individuals with the help of the tests in the present battery and to be well worth making a note of.

IX. SUMMARY AND CONCLUSIONS

We have, in the first chapter of this book, started with the desirability and necessity of devising intelligence tests, particularly for those countries which are as yet undeveloped. We have discussed the problems of intelligence testing in India in the context of the country's social and cultural conditions. We have indicated our general standpoint in regard to these problems and have defined the scope of the present investigation.

We have, in the second chapter, while discussing the general nature of intelligence, considered it helpful to give an historical background to the current theories of intelligence. We have traced the development of the theories of intelligence up to 1927—the date of the appearance of Spearman's work *Abilities of Man* and the enunciation of his theory of Intelligence in terms of *g*. We have discussed Spearman's *g*, have indicated our viewpoint and summarized what we consider to be a helpful and useful guide for those who have to devise tests of intelligence. Finally we have discussed the Performance tests of intelligence, and indicated the general principles of our battery of Performance tests.

In the third chapter we have given a detailed description of the tests constituting our battery, and in the case of tests specially devised by us for this battery, explained how these tests were devised. Instructions for administering the battery and the method of scoring the results have been given.

The fourth chapter contains details of the sample on which the standardization is based. In this connexion the difficulties of testing in the countryside in India have been pointed out and the way to meet them indicated.

The fifth chapter contains an account of the factorial analysis we carried out on our battery of tests together with the Stanford-Binet scale (1937 Revision-Scale L) by Thurstone's

centroid method with orthogonal axes. It was found that the battery gives the evaluation of at least two factors—a general factor, most probably of the nature of *g* and another, a memory factor. Indications of a third factor of the nature of *k* are also found, but it is not statistically significant in our analysis. This and other factors, particularly in connexion with our Picture test, may also be present in the battery but it was not possible to indicate or demonstrate these conclusively in view of the limited nature of data suitable for analysis.

The sixth chapter contains details of standardization of the battery under three separate heads (*a*) For literates with non-weighted raw scores, (*b*) For illiterates with non-weighted raw scores, and (*c*) For literates with weighted scores to give the best prediction for the general factor found in the analysis in Chapter V.

The reliability and validity of the battery are discussed in the seventh chapter, which also contains a comparison of the performance of the literate and the illiterate groups. The fundamental problem of test performance under different environmental conditions has been briefly discussed and the author's own view has been stated, which is that although environmental conditions do influence the performance of the subjects, so that it is not safe to pass judgement on the comparative merits of different groups on the basis of such tests, the test performance of an individual is nevertheless, as is generally recognized, a correct guide to the relative position of the individual within his group in regard to intelligence. This is distinctly supported by two results in our investigation also. Firstly we found that although the means of the two groups were different, the dispersions (i.e. the standard deviations) were practically equal so that the relative merits of individuals within the group were equally brought out in both the groups. Secondly we found that the IQ's of the illiterate group as determined by our battery are in remarkable agreement with the general opinion of the intelligence of the group as held by those who know it intimately. It

would thus appear that although environment and heredity both have a share in influencing the performance of an individual, yet within the same environment the influence of heredity in determining individual traits is predominant.

Lastly, we have given the results of sociological, educational and clinical interest for both the literate and the illiterate groups, as obtained from the present survey.

In conclusion we have to point out that the battery may be used with advantage on literate boys between the ages of 11 to 16 years to give an evaluation of their general intelligence and also to estimate an intelligence, mostly of a practical nature, as contrasted with verbal intelligence as measured by verbal tests of intelligence. This should be of help in guidance work in schools.

The battery may also be used confidently to assess the intelligence of illiterate boys between the ages of 11 to 16 years. This should be done with the help of the separate norms we have provided for the purpose. In the case of illiterates, the present investigation opens up a number of points, two of the more important, as they appear to us, being the investigation of the growth curve of intelligence from 15 years up to, say, 20 years, and the discovery, if possible, of tests (understood in the widest sense) which would reduce the gap between their performance and those of the literates.

APPENDIX

INSTRUCTIONS FOR THE ADMINISTRATION OF BHATIA'S BATTERY OF PERFORMANCE TESTS OF INTELLIGENCE

KOHS' BLOCK DESIGN AND PASSALONG TESTS (Tests No. 1 and 2)

1. Note the particulars of the subject as required in the scoring sheet. Note also whether the subject is literate or illiterate. Illiterate is one who has not been to a school or has not stayed there long enough to acquire ordinary reading and writing.

2. Note the observations very carefully and faithfully. Record the times as carefully as you can, with the help of a stop-watch as far as possible. A friend may help you in recording time.

3. Give the tests in a natural manner. Obtain the confidence of the subject. Talk in the subject's own dialect if possible. But stick to the procedure of the Tests rigidly. Give only as much aid or hint to the subject as is permissible. When the subject fails, do not put on a very serious look. Keep a cheerful businesslike attitude throughout.

4. Start testing with Kohs' Block Design Test :

   (1) Place four cubes before the subject. Explain how they are all alike and coloured in a particular way. Let him handle and examine the cubes at leisure and confidently, and let him feel at home.

   (2) Show him card No. 1. Tell him that a design like this has to be prepared with the cubes. Even if he attempts to prepare the design himself, you should demonstrate this design to every subject.

   (3) Mix up the blocks. Now ask him to prepare Design No. 1 as you have already shown him. Note the time.

   (4) If the subject succeeds in the above within the time limit, namely 2 minutes, proceed to Design

No. 2, and ask him to construct it without any demonstration or help from your side.

(5) Proceed in this manner with successive designs.

(6) When the subject fails in a particular design within the time limit, demonstrate the design after he has failed. Do not discuss. Do not let him again try this design. Pass on to the next which, of course, he must again try independently.

(7) When the subject comes to Design No. 6, give him *five* more blocks making the total *nine*; when he comes to Design No. 8, give him the remaining *seven*, making the total *sixteen*.

(8) Stop the test when failure has been recorded twice in succession.

(9) The time limit for Designs Nos. 1–5 is 2 minutes each and for Designs Nos. 6–10 is 3 minutes each.

(10) In the Remarks column you may note anything particular or peculiar you find about the subject in making the designs.

5. In giving the Passalong Test:

(1) Take the first and the smallest box, and the card No. 1. Point out to the subject that the red block has been placed near the blue end and the blue blocks near the red end. Explain that the red block must come to the red side and the blue blocks to the blue side as in the card. Emphasize that blocks have not to be lifted, but may only be moved.

Demonstrate the solution of the first box to every subject.

(2) Again place the card No. 1 and the box and ask the subject to do as you have already just demonstrated. Record success or failure within the time limit.

(3) Proceed to Designs Nos. 2, 3, etc. with the appropriate boxes, and after having placed the blocks properly in the initial position as required in the test. The initial position is obtained by simply reversing

the coloured ends of the box. The coloured ends of the box must however be finally placed before the subject as in the Design Card, which must be presented to the subject with the number of the card up.

(4) When the subject fails in a particular design within the time limit, demonstrate the design after he has failed. Do not discuss. Do not let him again try this design. Pass on to the next which, of course, he must again try independently.

(5) Stop the test when failure has been recorded twice in succession.

(6) The time limit for Designs 1 to 4 is 2 minutes each and for Designs 5 to 8 is 3 minutes each.

(7) In the Remarks column you may note anything particular or peculiar you find about the subject in solving the designs.

PATTERN-DRAWING TEST (Test No. 3)

1. There are eight patterns of increasing difficulty from the 1st to 8th.

2. Give the following instructions to the subject :

'Here is paper and a pencil. I shall show a figure to you [मैं यह एक शक्ल तुमको दिखाता हूँ]'. Place a card before the subject. Let the card be so displayed that the number of the card appears at the top before the subject. 'Now make a figure like this without repeating your lines and without lifting your pencil when once you have started drawing [ऐसी ही शक्ल खींचो । शर्त यह है कि (या, देखो) बनाना शुरू करने के बाद लाईन दोहराई न जाय और पेंसिल उठे नहीं]' The card should remain in full view of the subject throughout.

3. Let the subject try successive patterns. Stop when failure is recorded twice in succession.

4. Provide a plain white sheet of paper to the subject on which to draw the patterns. Successive patterns may be drawn

on the same sheet as long as there is room. Put the name of the subject at the top corner.

5. Allow a maximum of 2 minutes for each of the first four patterns. Allow a maximum of 3 minutes for patterns Nos. 5 to 8. The subject may make as many attempts on the paper as he likes within the time limit.

6. Demonstrate the first pattern, if necessary. It is only meant to give the subject confidence and facility in drawing.

7. When a failure occurs in one of the patterns, demonstrate this, but do not let the subject try this pattern again. Pass on to the next. Stop when failure is recorded in two successive designs.

8. Watch the subject while he is drawing. If he repeats a line or lifts his pencil, remind him of the conditions. Ask him to commence after proper thought. If he makes a drawing wrong, cross it out and ask him to start afresh. Encourage him to try as many times as he likes within the time limit before you record a failure in a particular pattern.

9. The solutions are given at the back of the cards. Try out the patterns yourself first. You will be able to see the device. Solutions other than those given are also possible and should be familiar to you.

IMMEDIATE MEMORY FOR SOUNDS (*a*) DIRECT (Test No. 4)

1. Immediate memory too has a close relation with mental development or general intelligence.

2. Hindi consonants have been taken as the units of sounds, because they put the literate and the illiterate at par.

3. Give the instructions to the subject :

'I will say something [मैं कुछ कहूँगा]. Listen attentively [ध्यान से सुनो]. Repeat it after I have finished [मैं जब कह चुकूँ तुम वह मेरे बाद कहो]. Listen [गौर से सुनो].'

4. We start with two letters (or sounds). This is merely to give practice to the subject. Read out distinctly and with even intonation. Proceed with more letters till failure is recorded.

Under each head we have given three alternative sets of letters. If failure is recorded in the first set, try the second and the third alternative sets. If failure is recorded in all the three alternatives, a final failure is recorded and we stop. We do not proceed up the series any more.

IMMEDIATE MEMORY FOR SOUNDS (*b*) REVERSED (Test No. 4)

1. The instructions in this part are :
   'Whatever I say you must say backwards. If I say "ka cha" you say "cha ka".' मैं जो कुछ कहूँ तुम उलट कर कहो। जैसे मैं कहूँ 'क च' तो तुम कहो 'च क'. Explain this reversal process clearly to the subject, if necessary using another set of two syllables as a second example.
2. Proceed up the series till failure is recorded. Failure means a failure in all the three alternatives of a particular set.

INSTRUCTIONS FOR PICTURE CONSTRUCTION TEST (Test No. 5)

1. This is the fifth and the last test of the battery.
2. This is a comparatively easy test for the age-group 11 to 16 years and has been purposely put in to enable some of the inferior children to score appreciably.
3. The Test consists of five graded sub-tests.
4. The general instructions will be :
   'Here are a number of pieces (specify 2, 4, 6, 8, 12 as the case may be) of a picture. Put the pieces together to form the picture. [यह एक तस्वीर के टुकड़े हैं—(२, ४, ६, ८, १२ जैसे भी किसी तस्वीर में हों). तुम इन टुकड़ों को मिलाकर पूरी तस्वीर बना दो।]
5. Start with the 1st sub-test. Most of the children will be able to do this themselves without your aid. In any case demonstrate and explain clearly what is to be done. This first sub-test is only to give practice and to let the subject understand clearly what is wanted of him.
6. Pass on then to the 2nd (picture divided into four parts), 3rd (picture divided into six parts), 4th (picture divided into eight parts), and 5th, the last (picture divided into twelve parts).

7. Follow the usual procedure, i.e.,

(*a*) If failure occurs in a sub-test, demonstrate and then pass on to the next.

(*b*) Stop with two successive failures.

8. If the subject is able to pass the first three sub-tests then in the fourth and fifth sub-tests, in case of failure, record not only failure but the number of pieces the subject was able to fit in correctly within the time limit, i.e. for example 6 out of 8 or 7 out of 8 in the case of the fourth sub-test and 6 out of 12, or 9 out of 12 etc. in the case of the fifth sub-test.

9. The time limit is 2 minutes each for sub-tests 1 to 3 and 3 minutes each for sub-tests No. 4 and 5. Record both the time taken by the subject and failure or success.

10. The pieces of a sub-test must be presented before the child in a pile in the serial order that has been marked at the back of the pieces. Of course the picture sides of the pieces will be exposed to the child. The numbers at the back are only to guide the examiner in placing the pieces in the desired standard order initially before the child.

The above has two exceptions. In the sub-test No. 1, put the two pieces side by side. In sub-test 5 put the pieces in two piles. In one pile, put pieces 1 to 6, and in the second, by its side, pieces 7 to 12. Pieces 1 and 7 will thus appear before the subject on top side by side to give him the initial correct start.

11. You can find out the solutions of the sub-tests easily yourself, but they are given below to make you perfectly sure about them. Make yourself familiar with the solution before you give the Test.

Solution : Sub-test 2

1	2
4	3

Solution : Sub-test 3

4	1	3
6	5	2

Solution : Sub-test 4

7	5
4	8
3	1
6	2

Solution : Sub-test 5

12	9	6
2	5	3
1	7	8
4	10	11

STANDARDS

SCORING

The scoring standards for the various tests are as under.

Both time and success are to be taken into account. The scoring standards have been kept as uniform and simple as possible.

KOHS' : For the first five designs, and for each design,
2 marks for success within a minute.
1 mark for success between 1 minute and 2 minutes.
0 mark for a failure, or success after the time limit.
For designs Nos. 6 to 10, and for each design,
3 marks for success within a minute.
2 marks for success between 1 minute and 2 minutes (but excluding 2 minutes).
1 mark for success between 2 and 3 minutes.
0 mark for a failure, or success after the time limit.
Maximum possible score : *25*

PASSALONG : For the first four sub-tests, and for each sub-test,
2 marks for success within a minute.
1 mark for success between 1 minute and 2 minutes.
0 mark for a failure, or success after the time limit.
For the last four sub-tests, and for each sub-test,
3 marks for success within a minute.
2 marks for success between 1 minute and 2 minutes (but excluding 2 minutes).
1 mark for success between 2 and 3 minutes.
0 mark for a failure, or success after the time limit.
Maximum possible score : *20*

PATTERNS : Exactly the same as for the Passalong Test.
Maximum possible score : *20*

MEMORY : Direct : One mark each for the number of digits or sounds in the maximum correct reproduction.
Maximum possible score provided for : *9*

Reverse : One mark each for the number of digits or sounds in the maximum correct reversed reproduction.

Maximum possible score provided for : *6*

PICTURES : Pictures 1 to 3, and for each of them,

2 marks for success within a minute.

1 mark for success between 1 minute and 2 minutes.

0 mark for a failure, or success after the time limit.

Pictures 4 and 5, and for each of them,

3 marks for success within a minute.

2 marks for success between 1 minute and 2 minutes (but excluding 2 minutes).

1 mark for success between 2 and 3 minutes.

0 mark for a failure, or success after the time limit.

For pictures 4 and 5, however, credit *in addition* to that earned according to the above schedule, is to be given as under :—

For picture 4 : 1 mark, provided that *at least* 6 of the 8 parts have been correctly put within the time limit.

For picture 5 : 2 marks provided that *at least* 9 of the 12 parts have been correctly put together, and 1 mark provided that at least 6 of the 12 parts have been correctly put together, both within the time limit.

Maximum possible score : *15*

Maximum possible score for the whole battery : *95*

TIME

The total time taken in the administration of the battery to a single individual is rather less than an hour.

TABLE 15

LITERATE GROUP

CONVERSION TABLE—FROM RAW SCORES TO IQ's

Age \ Scores	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
11 years	70	71	73	74	76	78	79	81	83	84	86	87	89	90	92	93	95	96	98	99	101
11 „ 6 months ..			70	72	74	75	77	78	80	82	83	85	86	88	89	91	92	94	95	96	98
12 „				70	71	73	74	76	78	79	81	82	84	85	87	88	90	91	92	94	95
12 „ 6 „ ..						71	72	74	75	77	78	80	81	83	85	86	87	89	90	91	93
13 „							70	71	73	74	76	77	79	80	82	84	85	87	88	89	90
13 „ 6 „ ..									70	72	73	75	76	78	80	81	83	84	86	87	88
14 „										70	71	72	74	76	77	79	80	82	83	85	86
14 „ 6 „ ..												70	72	73	75	76	78	79	81	82	84
15 „													70	71	73	74	76	77	78	80	81
15 „ 6 „ ..														70	71	73	74	76	77	79	80
16 „															70	71	73	74	76	77	79

TABLE 15

LITERATE GROUP

CONVERSION TABLE—FROM RAW SCORES TO IQ'S (*Continued*)

Age \ Scores	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59
11 years	102	104	106	108	109	111	113	115	116	118	120	122	124	126	128	130					
11 „ 6 months ..	99	101	103	104	106	108	109	111	113	114	116	118	120	122	123	125	127	129	131		
12 „	97	98	99	101	103	104	106	108	109	111	113	114	116	118	119	121	123	124	126	128	130
12 „ 6 „ ..	94	95	97	98	99	101	103	104	106	108	109	111	112	114	116	117	119	121	122	124	125
13 „	92	93	94	96	97	98	99	101	103	104	106	108	109	111	112	114	116	117	119	120	122
13 „ 6 „ ..	89	91	92	93	95	96	97	98	100	101	103	104	106	108	109	111	112	114	116	117	118
14 „	87	89	90	91	92	94	95	96	97	98	100	101	103	104	106	108	109	111	113	114	115
14 „ 6 „ ..	85	87	88	89	90	91	92	94	95	96	97	98	100	101	103	104	106	108	109	111	112
15 „	83	84	86	87	88	89	90	91	93	94	95	96	97	98	100	101	103	104	106	108	109
15 „ 6 „ ..	81	83	84	86	87	88	89	90	91	93	94	95	96	97	98	100	101	103	104	106	107
16 „	80	81	83	84	86	87	88	89	90	91	92	94	95	96	97	98	99	101	103	104	106

TABLE 15

LITERATE GROUP

CONVERSION TABLE—FROM RAW SCORES TO IQ'S (*Concluded*)

Age \ Scores	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
11 years																					
11 „ 6 months ..																					
12 „																					
12 „ 6 „ ..	127	128	130																		
13 „	123	125	126	128	129	131															
13 „ 6 „ ..	120	121	123	124	126	127	128	130													
14 „	117	118	120	121	122	124	125	126	128	129	131										
14 „ 6 „ ..	114	115	117	118	119	121	122	123	125	126	127	128	130								
15 „	111	112	114	115	117	118	119	120	122	123	124	125	126	128	129	130					
15 „ 6 „ ..	109	110	112	114	115	116	118	119	120	121	122	124	125	126	127	128	129	131			
16 „	107	109	110	112	114	115	116	118	119	120	121	122	123	124	126	127	128	129	130		

Table 16

ILLITERATE GROUP

Conversion Table—Raw Scores into IQ's

Age \ Scores	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
11 years	69	71	73	75	77	79	81	84	86	88	90	92	95	97	99	101	103	104	106	108	109
11 „ 6 months ..			70	72	74	77	79	81	83	86	88	90	92	94	96	99	101	102	104	105	107
12 „				69	71	73	76	78	81	83	85	87	90	92	94	96	98	100	102	104	105
12 „ 6 „ ..						70	73	75	78	80	83	85	87	89	91	93	96	98	100	102	103
13 „							70	72	74	77	79	82	84	87	89	91	93	95	97	99	101
13 „ 6 „ ..									71	73	76	79	81	84	86	88	91	93	95	97	99
14 „										70	72	75	78	81	84	86	88	90	92	94	96
14 „ 6 „ ..												71	74	77	80	83	86	88	90	92	94
15 „													70	73	76	80	83	85	87	89	91
15 „ 6 „ ..														69	72	75	79	82	85	87	89
16 „																70	74	77	81	84	87

TABLE 16

ILLITERATE GROUP

CONVERSION TABLE—RAW SCORES INTO IQ's (*Concluded*)

Age \ Scores	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
11 years	111	112	114	115	117	119	121	122	124	126	127	129	131							
11 „ 6 months ..	109	110	112	114	115	117	119	121	122	124	126	128	129	131						
12 „	107	109	110	112	114	115	117	119	121	123	125	127	128	130						
12 „ 6 „ ..	105	107	108	110	112	113	115	117	119	121	123	125	127	129	130					
13 „	103	104	106	108	110	112	113	115	117	119	121	123	125	127	129	131				
13 „ 6 „ ..	101	102	104	106	108	110	111	113	115	117	119	121	123	125	128	130				
14 „	98	100	102	104	106	107	109	111	113	115	117	119	122	124	126	128	130			
14 „ 6 „ ..	96	98	100	102	104	105	107	109	111	113	115	117	119	122	124	126	129	131		
15 „	93	95	97	99	102	104	105	107	109	111	113	115	117	120	122	124	127	129	131	
15 „ 6 „ ..	91	93	95	97	99	101	102	105	107	109	111	113	114	117	119	122	125	127	130	
16 „	89	91	93	95	97	99	101	103	104	106	108	110	112	114	117	119	122	125	128	130

TABLE 17

TABLE FOR OBTAINING WEIGHTED SCORES FROM RAW SCORES

Equivalent Weighted Standard Scores	Raw Scores			
	Kohs'	Passalong	Patterns	Pictures
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3, 4
4	4	4, 5	4	5
5	5	6	5	6, 7
6	6	7	6	8
7	7	8	7	9
8	8	9	8	10, 11
9	9	10, 11	9	12
10	10	12	10	13
11	11	13	11	14, 15
12	12	14	12	..
13	13	15	13	..
14	14	16	14	..
15	15	17, 18	15	..
16	16	19	16	..
17	17	20	17	..
18	18, 19	..	18	..
19	20	..	19	..
20	21	..	20	..
21	22	..	..	..
22	23	..	..	..
23	24	..	..	..
24	25	..	..	..

TABLE 18

LITERATES

CONVERSION TABLE FOR OBTAINING PQ'S FROM WEIGHTED SCORES

Age \ Scores	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
11 years ..			71	74	78	81	84	86	88	90	92	93	95	97	99	101	103	105	107	109	111	113	115	117	119	120
11 „ 6 months			69	72	75	78	81	83	86	87	89	91	93	94	96	98	100	102	104	106	108	109	111	113	115	117
12 „ ..				70	73	75	78	80	83	85	87	88	90	92	94	95	96	99	100	102	104	106	108	110	112	114
12 „ 6 „					71	73	75	78	80	82	84	86	88	90	91	93	94	96	98	99	101	103	105	107	109	111
13 „ ..					69	71	73	75	77	79	81	83	85	87	89	90	92	94	95	97	98	100	102	104	105	107
13 „ 6 „						70	72	74	76	77	79	81	83	85	87	88	90	91	93	94	96	97	99	101	102	104
14 „ ..						69	71	72	74	76	77	79	81	83	84	86	87	89	90	92	93	95	96	98	100	101
14 „ 6 „							69	71	73	74	76	77	79	81	82	84	85	87	88	90	91	93	94	96	97	99
15 „ ..								70	71	73	74	76	77	79	80	82	83	85	86	88	89	91	92	93	95	96
15 „ 6 „									70	72	73	75	76	78	79	81	82	83	85	86	88	89	91	92	93	95
16 „ ..									69	71	72	74	75	76	78	79	81	82	84	85	86	88	89	91	92	93

TABLE 18

LITERATES

CONVERSION TABLE FOR OBTAINING PQ'S FROM WEIGHTED SCORES (*Concluded*)

Age \ Scores	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
11 years ..	122	124	126	128	130																				
11 „ 6 months	119	121	122	124	126	128	130																		
12 „ ..	116	117	119	121	123	124	126	128	129																
12 „ 6 „	113	114	116	118	119	121	123	125	126	128	130														
13 „ ..	109	111	113	115	117	118	120	122	123	125	127	128	130												
13 „ 6 „	106	108	110	111	113	115	117	118	120	122	123	125	127	128	130										
14 „ ..	103	105	107	108	110	112	114	116	117	119	121	122	124	125	127	128	130								
14 „ 6 „	100	102	104	106	107	109	111	113	114	116	118	119	121	122	124	125	127	128	130						
15 „ ..	98	99	101	103	104	106	108	110	112	113	115	116	118	120	121	122	124	125	127	128	130				
15 „ 6 „	96	98	99	101	102	104	106	108	110	111	113	115	116	118	119	121	122	123	125	126	127	129	130		
16 „ ..	95	96	98	99	101	102	104	106	108	109	111	113	115	116	117	119	120	121	123	124	125	127	128	129	131

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